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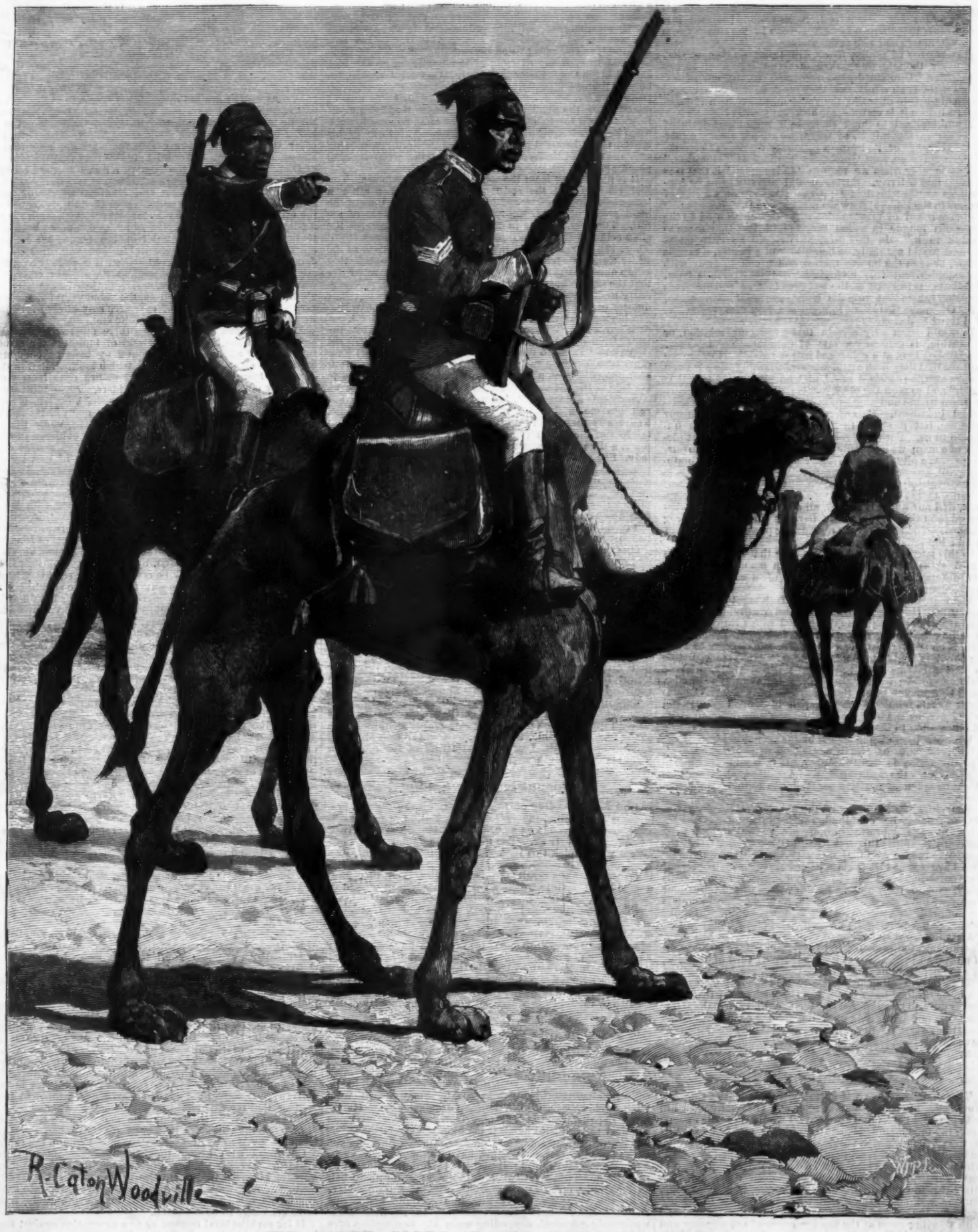


THE CAMEL CORPS OF THE EGYPTIAN ARMY.

CAMEL CAVALRY.

THE accouterments of the various belligerents now waging war in Egypt are of a curiously mixed character. The British have their squadrons of fine horses and revolving guns; the Arabs their ancient spears, with which they do fearful slaughter.

The Egyptian army is provided with a corps of camels on which armed men ride. A march of fifty miles a day is easily accomplished with these animals. Our engraving, which is from the *Illustrated London News*, shows the equipment of this curious branch of military service.

LATENT THOUGHT.

By D. Y. CLIFF.

REMARKABLE incidences of parallelism in thoughts are constantly occurring in everyday life, and in the wider field of human history, where whole races "think alike," and often it is the civilized world. Is it not a wonder a man is never born who thinks totally different, not only in style, but in logical sequence, to his fellow man? Nor is this nonsense, for I believe it is J. S. Mill who has said it is conceivable that there may be a species in the solar system with whom two and two make five.

It is worthy of notice, if we will think on the matter, how every thought we think is mentally expressed in our vernacular. Unpremeditated sentences spring out of our minds without an effort, but they must have been arranged internally before directing the vocal muscles. Is a thought spoken before it is considered, however swiftly?

I am inclined to think there is a continuous train of thoughts in our minds, of which we are not aware, either of its existence or its laws—a necessary result, so to speak, of the brain or nervous "molecular motion" or "vibration," and it is only when we require "to language" it that it is brought into activity. Surely mental activity must be constant, as we see with dreams; perhaps we are only aware of dreams in the interval between awaking and sleep.

I have heard of missionaries who became so used to the barbarous tongue in which they taught that they came to "think in it." Is there latent thought? This latent thought would naturally be hereditary in a family, a race, a nation, or even the human species, and would do away with any astonishment that no logical "confused" man is born. The brain, being part of the body, cannot be exempt from the same causes that rule the body—evolution, correlation, etc. Of course this latent thought is a very dim, vague sort of a thing to define.

It would seem only certain that a constant relation, or proportion, is generally a law of thought. For instance, two persons look at a color, and call it "red." How are we to prove that they both see identically the same effect? Each always sees one *constant result*, and he has learned to call it "red," and so with the other person, although it may really be green to one and blue to the other, in their relative individual judgment. This of course is no detriment to our thinking, but it shows there may be wide differences unknown to us. Perhaps every one of us has a different picture of a man; we have only learned things relatively to ourselves. We pity the poor frog who, with a partially brainless skull, answers with a meaningless croak the stroke on his extremities; but are we much better—*i. e.*, any different—in principle? It is but a more complex affair. We get a kick, and our anger is roused, all our nervous system is disturbed, and the tongue utters harsh sounds, like the frog croaked. Then there is the restraintive power of the human mind; but animals have that too.

In this latent thought lies the nature that maketh all the world akin; how alike is every human emotion! Is there any difference in the love language of a savage and an Englishman?

There are certainly traits of (latent?) thought in a nation's literature. How dull we find Oriental history, until it has time after time got thoroughly imbued with a European way of telling its story. Strange it is, too, what the effect of style is on writers; extracts from dry books seem to keep dry; writers on Oriental history (*e. g.*, China) seem unable to throw off its tone. We have literal translations of Chinese stories; what "stuff" they seem to the English mind! And yet often they approach very near. Colenso gives a Gala religious rhapsody; it is as good as a Psalm (which are, by the bye, the product of a very different stage of civilization to the present).

We cannot help being struck by the art productions of the Aryan, Semitic, or Hamitic division of the human race. The difference is most striking. One would venture to suggest that the sculptural remains of ancient nations might be taken as decisive testimony as to their respective races.

The stiff, hard drawing of the old Egyptian, Assyrian, etc., can never be confounded with the more exact conformity to the natural shapes of the Europeans, and most decidedly stamps this relative "latent power" of the respective races. And here it is not entirely "surroundings" that have formed their ideas of beauty—a principle one of your correspondents argued for in a former number. This might explain the very peculiar drawings of the Chinese or Japanese, but cannot be applied to the ancient world, unless we unfoundedly suppose that their forms—contours of limbs—were as harsh as designed, which is absurd, and would not have escaped the notice of the early European historian. The hideous sculptures of Indû gods can hardly be the work of an Aryan race. Nor is it an accidental turn of thought, like the nepotism of Travancore, Cochin, etc.

The human mind cannot conceive anything, as Mr. Cook, of Boston, has shown, and the "why?" of that question is only to be answered on the hereditary principle, our ancestors not being able even to guess the confines of space and time; yet still there are moments when we fancy we have an idea—but the world is in our brain.—*Jour. of Science.*

TOBOGGANING.

TOBOGGANING, says a Montreal correspondent of the New York *Sun*, is studied like a science. Originally, any hill with a straight road and a good slant would do for the sport; next, the tobogganers began to build big mounds of snow on top of the hills, upon which to give their boards a strong and swift start. But all that is too old fashioned for 1884. The rich snowshoe clubs now go into tobogganing regardless of expense. Having selected a good hillside, with a straight roadway a quarter of a mile long, they build long, slanting scaffolds at the top of the hill, fifty feet to seventy feet from the ground at the upper end of the incline, and with standing room at the top for scores of tobogganers and ladies. The inclined front of each of these scaffolds is boarded down to the point at which it meets the earth. Its surface is then divided into three, four, or five slides by ridges of snow, and these ridges are continued down the hillside. But snow is not good enough for the modern tobogganer to slide upon. It is only used for these ridges, which serve to keep the toboggans apart, and to prevent them from running into one another. The slides themselves are now coated with ice, made by pouring or sprinkling water between the ridges. The snow on the hillside is also wet and frozen, so that the whole quarter of a mile of hillside is a sheet of ice.

A high ridge of snow separates the slides from the path up the hill, and along this path the men drag their queer sleds, while the women gladly follow, all asserting that each time they climb the hill and the flight of easy steps up the scaffold they feel fresher and more eager for the sport than on the previous journey. Once on top of the scaffold, the tobogganer puts his toboggan down upon the flat platform, with its curved front end just over the edge. The girl who is to make the journey either puts her feet or her knees under the dashboard, according to how many are going down and how much room there is. The next passenger, if a girl, sits tailor fashion behind the first one; or, if a man, puts his legs on either side of the forward girl. If the riders are well acquainted and are enthusiastic tobogganers, the girl won't mind her companion putting his feet in her lap. It is the best and safest thing he can do, for a toboggan is thin and lies flat on the ice, and if a badly managed foot should touch the ice ever so lightly, it would send the toboggan flying out of its course. When all are ready, the passengers having got firm holds upon the little side rails at the edges of the slender board, the steerer throws himself forward upon the toboggan, so that he rests on one haunch upon it, with one leg free to steer with. The force of his movement and weight of his body send the frail board flying over the edge of the scaffold and down the steep ice-clad planking.

It is like falling from the roof of a four-story house. You feel yourself and the strip of birch veneer beneath you loosened from the earth and flying like a meteor toward the black crowd of spectators far below you at the foot of the hill. The very manner in which the toboggan grazes the slide makes it less reassuring than if it did not touch at all. There is a roar, a blast of intensely cold wind, a flash of the white walls of snow on either side, and then a comforting bump and grating as the less steep ground is touched. After that the supple board bends beneath its load in obedience to every undulation and slight hummock in its path. The quarter of a mile is made in thirty seconds. As the toboggan begins to slow up, the greatest danger is at hand. A man seizes its dashboard and at the same instant raises the ladies from their places and shouts, "Quick! quick! to the right!" or "Jump to the left. You haven't a second!" for other toboggans are rushing toward you on the same slide or are approaching on other slides the route you must take to the side of the road.

Accidents are frequent, but not often serious. Toboggans run into one another, but if both are free no harm is done. Frequently they lurch into the crowd that always gathers at the foot of the hill, and one sled will upset half a dozen people at a time. The worst mishap this year was to a young lady. She was in the care of a skillful steerer, but when the toboggan struck a big dog that ran out to bark at it, his skill was useless. The toboggan shot into the air, and he and the lady fell upon the ice and bowled along at thirty miles an hour. The young man said that she had fallen face downward, and he had tried to turn her on her back but could not. Part of her face was skinned, and she will be most horribly scarred for life.

One snowshoer has got a steel toboggan, but it is no faster and not half so safe as the birch ones. It would be a terrible engine of destruction in case it met with an accident. The best innovation is the hickory toboggan, that carries seven persons, which appeared on one of the slides just before carnival week. It is faster than a dream. Toboggans were always made by the Indians until very recently a factory was established here by white men. The Indian toboggans are even yet considered the best. They cost from $3.50 to $6, and weigh less than ten pounds without the mattresses that many use. The toboggan was originally meant for the transportation of heavy burdens over soft snow. It will not sink into snow as a sled would. But if a Yankee boy should bring a Connecticut double-ripper up here and start down one of these artificial glaciers it would go with the swiftness of a falling star, and it would not stop at the foot of the slide, but would dart on through Montreal and out upon the St. Lawrence at the foot of the mountain before it would begin to slow up.

PHOSPHORESCENT BRICKS.

AT a recent meeting of the Academy of the Natural Sciences, Philadelphia, the first communication which engaged attention was one on a curious phosphorescent variety of limestone from Utah. The miners had found that when struck with a pick this rock gave out a lurid red light, lasting from half a second, when merely touched, to a much longer time, as the result of a blow. They had, therefore, named it the hellfire stone. On examination it proved to be an almost perfectly pure carbonate of lime, with but a slight percentage of impurities. It is a loose grained, white, crystalline limestone, the grains of which are but slightly coherent, giving the rock the appearance of a soft sandstone. It crumbles easily between the fingers, forming a coarse sand. Phosphorescence is developed when the rock is either struck, scratched or heated. When heated in a glass tube over a flame it glows with a deep red light, which lasts for a minute or more after withdrawing the flame. After two or three heatings the phosphorescent property disappears.

A search through the collection of the Academy for limestones having similar properties resulted in finding specimens from Kaghberry, in India, which glowed with a strong yellow phosphorescence when heated, although no such effect was produced by scratching or striking. It was of great interest to find that the Indian limestone alone of all in the collection had the precise external characters of that from Utah. This similarity is more than a coincidence. It confirms Becquerel's view that phosphorescence depends upon physical rather than chemical conditions. Professor Lewis had been fortunate enough to observe the rare phenomenon of the phosphorescence of snow, having seen a snow covered Alpine mountain shining at night as though illuminated by moonlight. This beautiful appearance lasted for about half an hour only, and was confined to a single mountain. Here again the phosphorescence, although of quite a different character from either of those belonging to the limestones, was purely physical, depending upon the assumption of a certain crystalline condition by the snow. The phosphorescence of hellfire rock is probably dependent upon a disturbance of its loosely aggregated crystalline particles, whether such be produced by percussion, friction, heat, or decrepitation.

EARTHQUAKES AND BUILDINGS.

A COMPLETE discussion of the effects which earthquakes produce upon buildings would form a treatise as useful as it would be interesting. Not only would it involve a discussion of the practical lessons to be derived from the actual effects of earthquakes, but it would include deductions based on our present knowledge of the nature of earthquake motion. Such knowledge is obtained from the records of seismographs.

In the following few notes I intentionally overlook this latter portion of the subject, and confine myself to a few of the more important practical conclusions respecting the effect of earthquakes on buildings, which may be of value to those whose mission it is to erect buildings in earthquake countries.

With regard to the situation of a building, it is sometimes observed that after an earthquake it is the portion of a town situated on low ground which has principally suffered, while adjoining portions on hills may have practically withstood the disturbance. In 1855 this was the rule governing the distribution of ruin in Tokio. The reverse, however, has been the rule in Yokohama. Speaking generally on this point, it may be said that there is no universal rule—each small area in an earthquake region having its special rule. As a site for a building, theory seems to indicate that soft earth or marshy ground, which would absorb much of the momentum communicated to it, and therefore act as a buffer between a building and a shock approaching through other strata, would prove a safe foundation. This seems also to have been an old opinion, for we read that the temple of Diana was built on the edge of a marsh to ward off the effects of earthquakes; but experience has repeatedly shown us, as in the case of Tokio and Manila, that swamp-like ground, as an earthquake palliative, has but little effect. On the other hand, hard, rocky strata, where the amplitude of motion is small, but the period quick as compared with the motion in the inelastic material of the plains, has, as was markedly illustrated in 1755 at Lisbon, and in 1692 at Jamaica, proved the better foundation. Places to be avoided are the edges of cliffs, scarps, and cuttings. For emergent waves, these are free surfaces, and from their faces materials are invariably shot off, much in the same way that the last car in an uncoupled train of carriages may be shot forward by an engine bumping at the opposite end.

As foundations for a building there are two types. In one, which is the European method of building, the structure is firmly attached to the ground by beds of concrete, brick, and stone. In the other, which is illustrated in the Japanese system of building, the structure rests loosely on the upper surface of stones or bowlders. As an indication of the relative value of these two forms of building, it may be mentioned that in Yokohama, in 1880, many of the European buildings were more or less shattered, while in the Japanese portion of the town there was no evidence of disturbance.

The houses, like the foundations, are also of two types. In the European house built to withstand earthquakes, of which there are examples in Tokio and San Francisco, and for which in America patents have been granted, we have a building of brick and cement bound together with hoop iron and numerous tie rods. A building like this, which from time to time is jerked backward and forward by the moving earth, to which it is secured by the firmest of foundations, is expected to resist the suddenly applied and varying stresses to which it is exposed, by the strength of its parts. This type of structure may be compared to a steel box, and, if its construction involves any principle, we should call it that of strength opposing strength. Some of the buildings in Caraccas, which are low, slightly pyramidal, have flat roofs and which are bound along their faces with iron, belong to this order. These so-called earthquake-proof buildings, with the exception of their chimneys, have certainly satisfactorily withstood small earthquakes in Japan. As to how they would withstand a disturbance like that at Casamicciola is yet problematical. Unfortunately these structures are very expensive.

The second type of building may be compared to a wicker basket. This is certainly as difficult to shake asunder as the steel box type, and at the same time is not so expensive. The Japanese house belongs to this type. It is largely used on the west coast of South America; and in Manila, since the disaster of 1880, it has rapidly been replacing the heavy stone form of structure. Briefly, it is a frame house with a light roof of shingle, felt, or iron. As put up in Japan, its stability chiefly appears to depend on the fact that it is *not* firmly attached to the earth on which it rests, and that its numerous joints admit of considerable yielding. The consequence is that, while the ground is rapidly moving backward and forward, the main portions of the building, by their inertia and the viscous yielding of their joints, remain comparatively at rest.

A house that my experience suggests as being aseismic, and at the same time cheap, would be a low frame building, with iron roof and chimneys supported by a number of slightly concave surfaces resting on segments of stone or metal spheres, these latter being in connection with the ground. Earthquake lamps, which are extinguished on being overturned, would lessen the risk of fire, while strong tables and bedsteads would form a refuge in case of sudden disturbances.

In earthquake towns the streets ought to be wide, and open spaces should be left, so that the inhabitants might readily find a refuge from falling buildings. Brick chimneys running through a wooden building, unless they have considerable play and are free from the various portions of the building, are exceedingly dangerous. In consequence of the vibrational period of the house not coinciding with that of the chimney, the former, by its sudden contact with the latter when in an opposite phase of motion, almost invariably causes an overthrow. In 1880 nearly every chimney in the foreign settlement in Yokohama was overthrown in this manner, and the first alarm inside the houses was created by a shower of bricks falling on beds and tables. Since this occurrence the chimneys in Yokohama have had more or less play given to them where they pass through the roofs.

Chimneys with heavy tops, like heavy roofs, must be avoided. Another point requiring attention is the pitch of a roof. If this is too great, tiles or slates will be readily shot off. Archways over openings should curve into their abutments, otherwise, if they meet them at an angle, fractures are likely to be produced.

If for architectural reasons, or as a precaution against fire, it is necessary to have buildings that are substantial, their upper portions ought to be as light as is consistent with the

requisite strength. Hollow bricks, light tiles, with *papier-mache* for internal decorations, have been recommended as materials suitable for superstructures. At the present time the city of Manila, partly through Government interference, and partly through the desire of the inhabitants to reduce the chances of further disasters, presents a singular appearance of light superstructures rising from old foundations. Iron roofs are visible in all directions, while on the massive basements of old cathedrals and churches upper stories of wood, with cupolas and spires of corrugated iron, have been erected.

Although the suggestions embodied in the above notes are few in number, it is hoped that they may be of some practical value. Without extending them, they show us that, even though we may not be in the position to escape from earthquakes by forewarning ourselves of their approach, we can at least mitigate the effects of these disasters by proper construction.—*John Milne, in Nature.*

KEEPING BOILER TUBES TIGHT.

A VERY important question, and one which has been a source of great trouble and anxiety to all torpedo boat builders, is the difficulty experienced in keeping the boiler tubes tight in the tube plate. This difficulty is one familiar to all locomotive engineers, but is augmented to a great extent in torpedo boat boilers. Whether this increased trouble be due to certain differences which exist in the design, to more

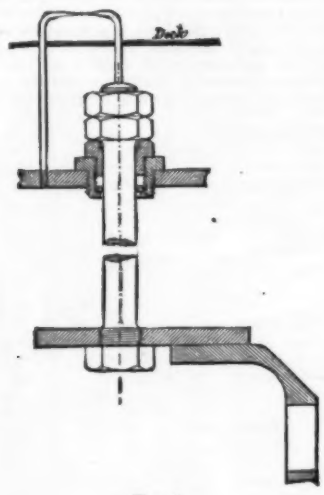
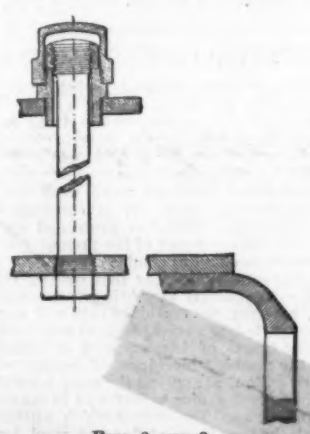


FIG. 1.

sudden fluctuations of temperature, or to the fire being forced to a greater extent, or whether it be due to all three causes combined, is a matter for consideration. No doubt in different boilers the trouble may arise from different circumstances, and therefore it is impossible to lay down a rule common to all cases. It has been found by the experience of a large number of years that the tubes, arranged as they customarily are in locomotive boilers, are themselves a sufficient stay to the tube-plates; and it is also the opinion of a large majority of locomotive engineers that it is unnecessary and unwise to put solid stays or stay tubes between the tube-plates. When brass tubes are used, great care should be taken that the quality and mixture of all the tubes is the same, so that they may all have the same rate of expansion and contraction. A most important point to be considered in this question is the material of which the fireboxes and tubes could be constructed; Messrs. Yarrow & Co. state that they generally adopt copper fireboxes and brass tubes, bearing in mind the experience of locomotive engineers in this country that iron fireboxes after a little use are subject at any moment to crack between the tube holes. The difficulty of unequal expansion and contraction is no doubt augmented by having for the tubes and firebox a material enfirely dissimilar to that of the outside shell. There is an element of difference between a locomotive and torpedo boat boiler which has been previously pointed out in the columns of *Engineering*, viz., that the vibration to which a locomotive is subject when traveling may possibly materially assist the bubbles of steam which form on the heating surfaces to free themselves and pass away; while in the case of the torpedo boat they might remain attached to the surface, allowing



FIGS. 2 AND 3.

it thereby to become overheated; how far this may operate to augment the difficulties alluded to, it is impossible to say. Messrs. Yarrow & Co. consider that the chief cause of the trouble hitherto experienced is due to the alteration in the form of the tube-plate by its being drawn out of shape, and some four years since they investigated the subject with a view to arrive at a correct conclusion.

In order to ascertain precisely what was going on in the inside firebox of a torpedo boat's boiler, they arranged for all those stays which united the inside and outside fireboxes next to the tube-plate flange to be replaced by movable stays working in stuffing-boxes, designed in such a manner that they might if required still act as stays, but if the copper firebox expanded, as it was only natural to expect it would, then these stays were free to project through, and by careful measurements a record was obtained of how the copper box was acting. Fig. 1 shows the arrangement adopted. In the course of trials some of these stays were found to move outward as much as an eighth of an inch when the firedoor was closed and the fire had burnt up. When the door was opened for firing, causing a reduction in the intensity of the combustion, they were drawn back, thus affording evidence of the exact amount of contraction and expansion of the firebox. The conclusion arrived at by these trials was, that if instead of the firebox having been allowed to move in accordance with its natural tendency it had been rigidly secured by fixed stays, something must ultimately have given way. The time when the leakage usually occurs is not when the firebox is expanded, but at the moment when, the fire being lowered, contraction takes place upon the rate of combustion being reduced, thus clearly showing the desirability of the firebox being designed to admit of its free expansion, and also of its contraction to its exact original form.

The result of these experiments has been that in all the boilers made for these torpedo boats the first row of stays next to the tube-plate is allowed full liberty to move, the arrangement adopted being shown by Fig. 2. From this view it

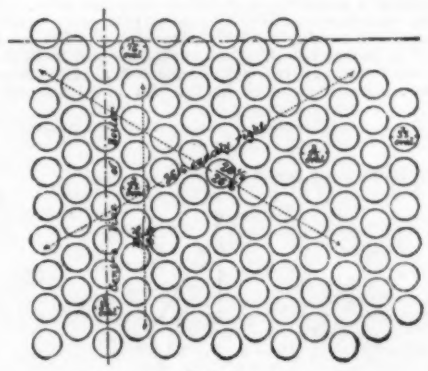


FIG. 4.

will be seen that the outer end of each stay, instead of being screwed into the shell plate, is furnished with a nut which bears against the outer end of a nipple screwed into the shell plate, and through which nipple the stay can slide. On the nipple is screwed a cap which covers the end of the stay and prevents any leakage. To give further elasticity also the flanges of the tube-plate and the portions of the plate outside the tubes are thinned down as shown in the section, Fig. 3. The firebox can thus accommodate itself to variations of temperature, and now a leaking tube-plate seldom is noticed, although before it was the rule rather than the exception. While speaking of this subject we may mention that in the course of their investigations of the cause of tube leakages Messrs. Yarrow gauged some tube-plates before and after steam had been got up in the boilers to which they belonged. Fig. 4, annexed, shows the result of one such set of gaugings taken in August, 1879, from a boiler with a barrel 4 feet 6 inches in diameter, and fitted with 2 inch tubes 7 feet 7¾ inches long between tube-plates. Where two sets of dimensions are given in the diagram, the larger dimension of the two shows the distance between tube centers after the boiler had been in steam, and the smaller the distance before steam had been got up. Thus it will be seen that in one case the distance between the centers of a diagonal row of eleven tubes increased from 26⅛ inches to 26¾ inches, while a vertical dimension at another part of the tube-plate increased from 18¾ inches to 18⅞ inches. Several of the tube-holes also became oval as marked. These are certainly remarkable, and would be to most engineers unexpected results.—*Engineering.*

A NOVEL LIFE BOAT.

To the Editor of the Scientific American:

The undersigned, a steady—I would say a studious—reader of your incomparable paper, noted an article concerning the question of a good life boat (SCIENTIFIC AMERICAN, Feb. 2, 1884). I am happy to state that the writer of the article alluded to met exactly my ideas about the need and requirements of such a life boat, which I had some time previously projected.

In the accompanying drawings, Fig 1 represents the boat, built of iron (sheet iron or steel), half in elevation and half in vertical section to show the interior. Fig. 2 represents the interior of the boat, the oars acting as masts. Fig. 3 is a cross section of the central part of the boat.

In Fig. 1, A represents the ventilator, B the pump, C the wheels, which when turned by the cranks, XX, impart motion to the ventilator by means of a chain, and operate the pump by means of the crank. The ventilator and pump can be used separately. D is a tube with large mouth having a valve underneath, to take any water coming through the ventilator as indicated by the arrows. When the safety valve, E, is closed all communication with the outer air is shut off, and, obviously, no water can get in. F are four round doors in the upper part of the life boat, provided with plain and strong spring locks arranged for being opened both from the outside and inside. These doors are to be opened for entrance and exit of people.

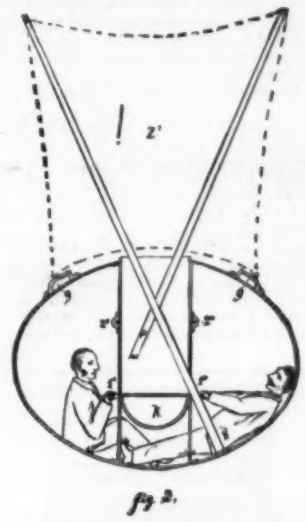


fig 2.

When rowing, the oars are propped on the piece, *g*, the door also serving as a support. When in a crossed position they can be made to carry a small sail, as shown by the dotted lines in Figs. 1 and 2. For directing the course of the boat one of the oars may work on a pivot, G, at the end of the boat. The bars 1 and 2 are to be grasped by the passengers to enable them to resist the shocks of the sea; the lower bar allowing them to keep a sitting position, while they grasp the upper bar when standing. HH are a number of vertical pieces on which the occupants rest their feet. M is a reservoir for holding drinking water, one being at each extremity of the boat. K is an hermetically sealed repository for provisions. N represents one of the glasses for the light holes. O is one of the rings, on the deck, in such a situation as to facilitate the introduction of the people through the door, P^2. The ring is fixed by means of a rope which is to be cut when the boat is thrown into the sea.

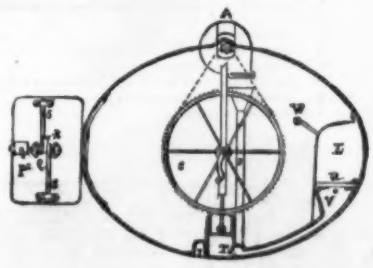


fig 3

Fig. 3 plainly shows the principal entrance, P^2, which is closed by means of a plain spring lock, to be opened very easily from either side. All the doors are provided with packing. The seat, *v*, in the closet is furnished with a lid to be kept closed against mephitic exhalations. When in use the action of the pump is stopped by the valve, T, the lateral faucet is lifted, allowing water to enter from the outside into the vase, V. By means of the pump the cleansing takes place through the valve, T, and the hole, Z.

The interior of the boat may be covered with boards to protect the people from moisture when leaning against the sides.

GUISEPPE PACI.
208 Elm St., New York city.

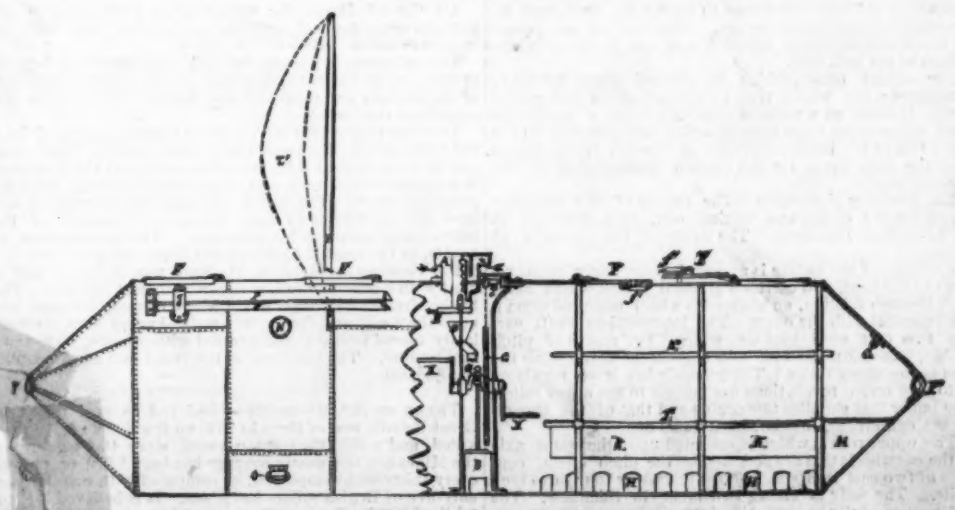


FIG. 1.—PROPOSED LIFE BOAT.

THE NEW MARINE DREDGING VESSEL FOR THE PORT OF COLON.

WE present in the accompanying engraving (from *Le Genie Civil*) sections of the powerful dredger which made the trip unaided from Scotland to the Isthmus of Panama, and which has, for several months past, been operating at the port of Colon.

The vessel consists of the following parts: (1) hull; (2) framework of the dredging apparatus; (3) the dredging apparatus and its engine; (4) the maneuvering windlasses; and (5) the propeller, its engine, and the navigating apparatus.

The Hull.—This is 170 feet in length, 30 feet in breadth amidships, and 12 feet in depth. When in service it draws about eight feet of water. The bucket channel, which begins amidships, but does not extend entirely to the bow, as it was necessary that the latter should be tapering (in view of the fact that the vessel was to be sea-going), is 6 feet in width. This well or channel is lined with iron plate 0·44 of an inch in thickness.

The floor timbers are of iron plate strengthened by angle iron.

The frame is made of angle irons. The bottom of the hull is strengthened by three T-iron keelsons, the central one of which terminates at the bucket well. The hull is divided by bulkheads into four water tight compartments, the two smallest of which are situated in front and to the rear of the bucket well. The deck, which is of pitch pine, is 3 inches in thickness.

The Framework.—Over the deck rise two frames of iron, plate and angle iron. The first and most important of these supports the bearings of the axle of the upper roller and of the parts that transmit motion to it. It is formed of iron plate about 3 inches thick, and is strengthened by posts composed of iron plate 12x0.4 in., and angle irons of 3·4 x3·04x0·4. Its height, up to the axle of the roller, is 24 feet. To the right and left of this frame are adapted the spouts, which are 3 5 feet wide and 6 inches in depth, and have an incline of about 30°. They are of iron plate 0·3 of an inch thick, and are lined with 0·4 inch thick steel plate in order to resist the continuous friction of the excavated material and the resulting wear. The chutes have a movable and hinged part which has sufficient range to empty the dredgings in the middle of the hopper barges. The sides of the frame are prolonged obliquely forward and are fastened to the streaks of the well hole.

The second frame, which is situated nearer the bow, constitutes a gin, which rises to a height of 31 feet above deck. It serves as a point of attachment for a quadruple block whose ropes draw upon a swing bar attached to the lower end of the bucket ladder. A two-ton crane placed upon the deck serves for the special maneuvering of the bucket chain.

The Dredging Apparatus.—The engine of the dredging apparatus is a compound vertical one, with cylinders 21 by 42 inches in diameter. The stroke of the piston is 24 inches.

The shaft of the engine is arranged transversely with respect to the boat, and carries a grooved pinion which actuates, through friction, an analogous wheel mounted upon a shaft parallel with the other. The intermediate shaft carries two cast steel pinions, which, by means of pitch chains, transmit motion to two cogwheels keyed upon the axle of the upper roller. The transmission is so regulated as to give seven revolutions per minute to the upper roller. The boiler that supplies this engine and that of the propeller is a cylindrical, tubular, back-flame one.

The upper roller, which is mounted upon the same axle as the cogwheels that are actuated by the pitch chain, consists of two cast iron cheeks cross-braced by four three-inch bolts. The felly is about two inches in thickness. The hubs are carefully hooped with iron circles sprung on hot.

The bucket ladder consists of two posts constructed of plate and angle iron, and is sixty feet in length, thus permitting of dredging to a depth of 36 feet below the surface. The two posts are cross-braced by five iron plates 0·2 inch thick. At its upper part the bucket frame is traversed by a shaft whose journals work in bearings that are movable in guides formed in the central framework. The travel of the bearings in these grooves is 3·5 feet. This motion of the axis of revolution in guides has an important role. As the dredger is submitted to surges the bucket ladder might abut against the bottom through the intermedium of the lower drum. Now, if the point of revolution were fixed, it would receive the entire shock; and if on another hand the sliding in the grooves were absolutely free, the upper extremity of the bucket frame, being violently thrust upward, would abut against the end of the guides, and, in either case, a breakage would occur. This whole trouble is avoided in the arrangement here adopted. The bearings of the axle of the upper roller are first carried to the proper height to tauten the bucket chain, and are prevented from descending by passing a bolt under them through the cheeks of the guides. These latter contain, at their upper extremities, Belleville springs of a total force of 40 tons. The space comprised between these springs and the movable bearings is filled by a wooden liner. The springs therefore receive the shocks produced by the upward motion of the bucket frame. The downward motion, which is less violent, since it depends only upon the weight of the frame and the bucket chain, is limited by the bolts above mentioned.

At its lower part the bucket frame carries a hexagonal roller over which passes the bucket chain, and which is analogous in construction to that of the upper roller.

The buckets, which have a capacity of 88 gallons, are of 0·4 inch iron plate with cutting edges of steel. The bottoms are of ¾ inch cast steel. Each bucket is separated from the one that follows by two links of one meter. Each element of the chain comprises one bucket with hinge attachment, two flanged links of forged steel, and four steel hinge bolts 3·5 in. in diameter.

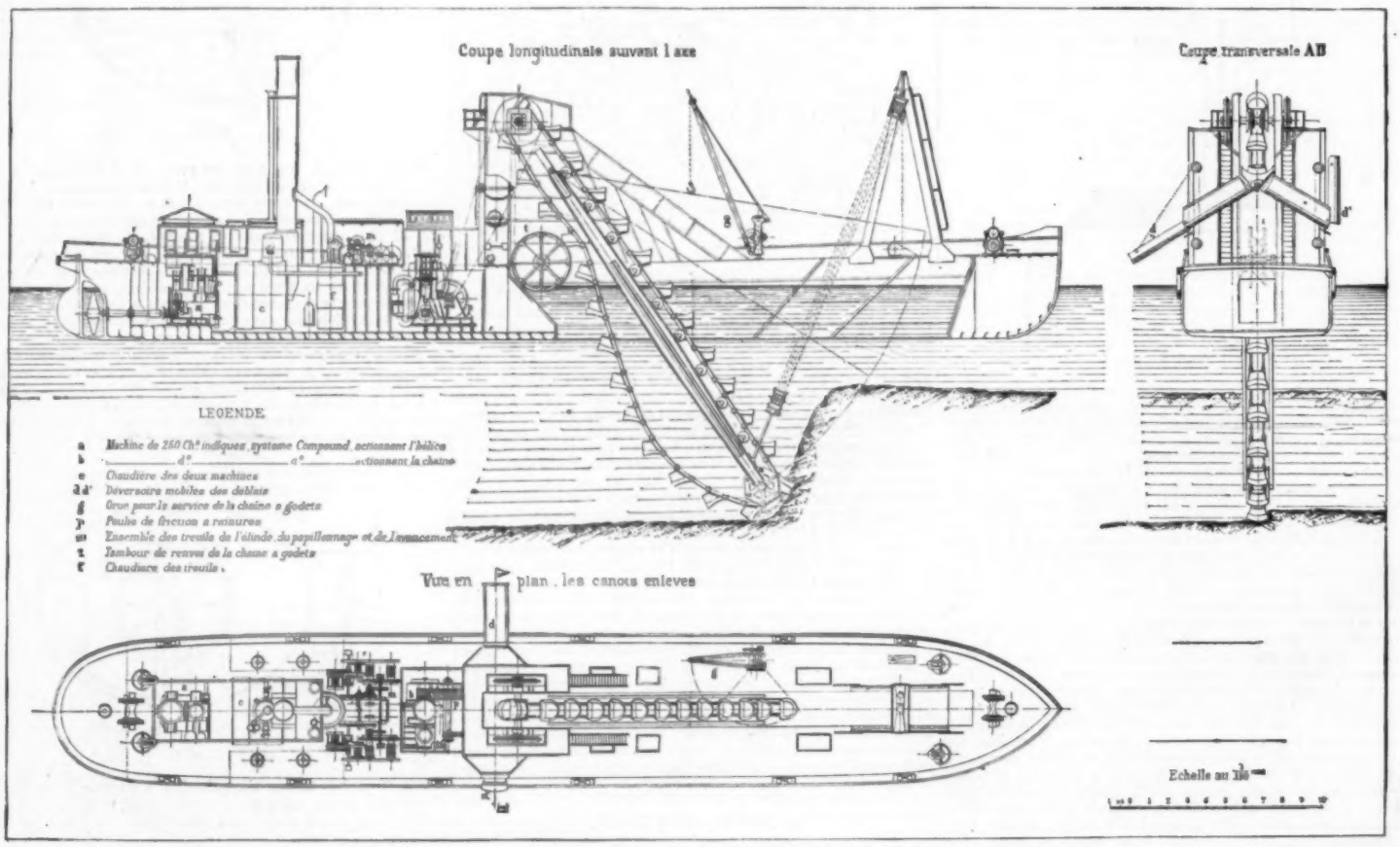
The drum for supporting the bucket chain is about ten feet in diameter, and is mounted in the interior of the bucket well on iron brackets that may be moved so as to slightly vary the position of the drum with respect to the dredge chain.

All the windlasses for maneuvering the apparatus are grouped upon the deck, with the engine that runs them in the center.

This arrangement permits the man in charge of the engine to more easily watch the different phases in the operation of the dredger and to receive his orders directly from the captain of the vessel.

The boat is provided with a screw propeller actuated by a 250 horse power compound engine with surface condenser, and in every respect identical with the bucket chain engine. It is located in the stern, and is connected directly with the propeller shaft. The speed obtained at sea reaches and even exceeds 8 knots an hour, without the pressure of the boiler rising above 5 kilogrammes. The consumption of coal is, at the most, 2·5 pounds per horse and per hour.

For crossing the Atlantic, the boat was provided with a mast with a schooner sail, a square sail, and two jibs. The bucket frame and bucket chain were dismounted and laid upon the deck, and the bucket well, having been hermetically closed beneath and covered with a hatch, served as a coal bunker. The total cost of the vessel and her apparatus was $88,000.


Coupe longitudinale suivant l axe
Coupe transversale AB
LEGENDE
a Machine de 250 Ch^x indiquées, système Compound, actionnant l'hélice
b " d° " d° " actionnant la chaine
c Chaudière des deux machines
d d' Déversoirs mobiles des déblais
f Grue pour le service de la chaine a godets
p Poulie de friction a rainures
m Ensemble des treuils de l'étinde, du papillonnage et de l'ancrement
t Tambour de renvoi de la chaine a godets
t' Chaudiere des treuils
Vue en plan, les canots enlevés
Echelle au 1/50

THE NEW DREDGING BOAT FOR THE PORT OF COLON.

THERE are 500,000 persons employed in coal mines in Great Britain, and of these in 1878 no fewer than 1,413 were killed, and within the last ten years, since the pasaing of the Mines act, the yearly average has been 1,200, or one in every thirty-eight employed, as compared with one in seventy-five of British sailors lost at sea. It is believed the total lives lost in English mines is 2,500 every year, forty-eight every week, or eight every day.

NEW STEAMER RUAPEHU.

THE New Zealand Shipping Company's new steamer Ruapehu left Plymouth on January 12 for Auckland *via* the Cape. The Ruapehu is a very fine vessel of 4,170 tons register and 4,000 horse power, built entirely of steel by Messrs. John Elder and Co., of Govan, Glasgow. She is bark rigged, having yards and masts of steel with a large spread of canvas, which should prove of great service in the trade winds. It is calculated that with her powerful engines she will make an average speed of over 300 miles per day. The vessel is divided into eight watertight compartments; five divisions are carried up between the main and upper decks and are fitted with watertight and fireproof doors, giving easy access from one part of the ship to another. The principal dimensions of the vessel, which is built under special survey with a view to the requirements of Lloyd's highest class, for hull and machinery are as follows: Lengths between perpendiculars 380 ft., length all over 410 ft., breadth 46 ft., depth 33 ft. 4 in. The engines are compound surface-condensing, and have two inverted cylinders, one high pressure, 46 in. in diameter, and one low pressure, 88 in. in diameter, each adapted for a stroke of 4 ft. 9 in. The steam is supplied to the engines by three cylindrical double-ended multitubular boilers, having in all 18 of Foxe's patent corrugated furnaces. The boilers are constructed entirely of steel, and made for a working pressure of 110 lb. per square inch. The Ruapehu, with her sister vessels, has been entered on the Admiralty lists as a transport of the highest class. Accommodation is provided on the main deck for 80 first, 80 second, and 250 third class passengers. The vessel is fitted throughout with the electric light. Refrigerating chambers with two refrigerating engines of the most improved type are fitted in the forehold for the carrying of about 1,200 tons of frozen meat for the English market. These chambers are also utilized for the carrying of an ample stock of fresh provisions for the use of the passengers on the voyage out, such as frozen tins of milk, carcasses of mutton, bullocks, pigs, fowls, and fish.

IMPROVED COMBING MACHINE.

THE combing of fibrous materials, whether of animal or vegetable source, is an art of ancient origin. Into this, however, we need not inquire; suffice it to say that the monuments of Egypt and Assyria, in their picture writings, show the process of heckling flax, which is one form of combing, and that the art had advanced to a degree of perfection beyond which it did not move until the advent of the present mechanical epoch. Wool combing is probably quite as ancient, and doubtless proceeded on much the same lines until the early part of the present century. Attempts to invent mechanical combers were made toward the close of the last century, notably that of Dr. Cartwright's, which came comparatively near being a commercial success. It required, however, the combined skill and experience of several inventors before a good practical result was achieved. Since then the course of improvement in detail has been steady, and the combing machines of to-day, whether for flax, wool, or cotton, are among the most beautiful and interesting triumphs of genius to be found in connection with the textile industries. The success which attended the efforts to comb the long fibers of flax and wool by mechanical means no doubt suggested a similar treatment of cotton, and subsequently of silk waste, and the future will certainly reveal other fibrous materials to which the same treatment will be appropriate. The first successful adaptation of the combing machine to cotton was by Heilmann, about the year 1846. His attempt was not however regarded with much favor until in a more perfected form it was brought before the notice of the English trade at the exhibition of 1851, when a Manchester syndicate secured the invention for this country, made the machine, and controlled its sale for many years. During this time, on the suggestions of experience

it was successively improved. After the expiry of the patent, various machinists who took up its construction worked at its simplification and further improvement with considerable success. These efforts have since been continued.

We have much pleasure in introducing to the notice of our readers the latest, and one of the considerable steps forward in the way of perfecting this machine that has of late years been made. It is the joint invention of Messrs. John Thompson and Thomas Barker, and emanates from the well known firm of Messrs. Curtis, Sons & Company, Manchester, with which both gentlemen are connected, the former as a partner and the latter as a foreman. Our illustration, Fig. 1, giving a perspective view of the machine, admirably shows its general structure, and indicates to a considerable extent the changes that have been made in its external appearance. The most notable of these visible to the eye is the placing of the gearing in the center of the frame, whereby a diminished liability to torsion in the shafts is secured, and the addition of two heads, making eight in the new machine in place of six in machines as ordinarily constructed. It will be observed also that the machine gains in general compactness, by which space can be economized. The changes that have been made allow an increased thickness of lap, and thereby greatly increase the production, while at the same time it is very obvious on inspection of the result that the quality of the work is also greatly improved. The means by which

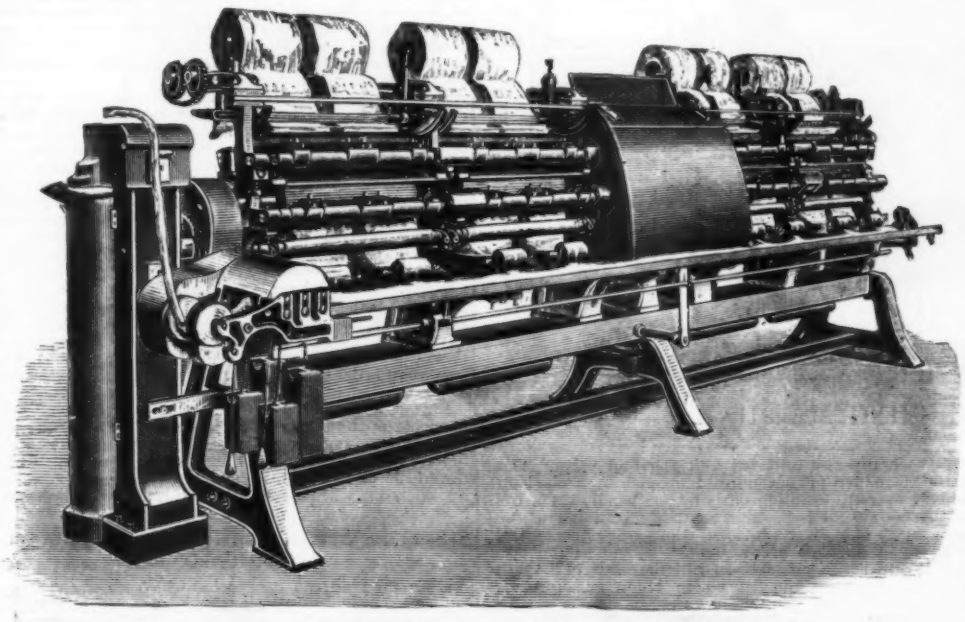


FIG. 1.—IMPROVED COMBING MACHINE.

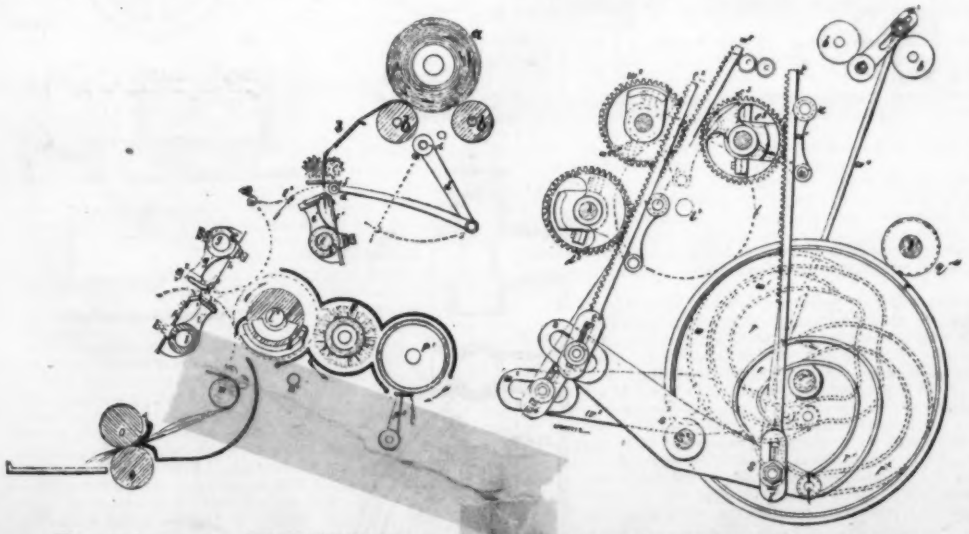
these changes are wrought may now be briefly described. Ordinarily one end of the fiber is combed with a cylinder comb, while the other end is so treated by drawing it through a top comb having one or more rows of needles. The inventors, however, have succeeded in devising an arrangement by which they use three pairs of nip-jaws and one combing cylinder for each head. The first of these nippers seize the end of the lap and draw from it a portion of the material, which they place at any required distance in the second pair, which then draw one end of the fibers through the cylinder combs. As soon as this is combed the fiber is carried onward and placed in the third pair of nippers, which draw the uncombed end through the same cylinder combs as before, after which they carry the material forward and place it between rollers that form it into a fleece. The means by which these movements are accomplished will be adequately shown by the following illustrations, Fig. 2 being a sectional view of the working parts of the machine, the frame being omitted to keep it clear. The lap, A, is placed upon the friction rollers, BB, whose revolution unwinds the lap sheet which passes over the top conductor, B^1, from which it is received by the fluted feed rollers, CC. After it has passed between these it is subjected to the action of an oscillating rod, D, the function of which is to level the web of the material before it passes to the combs. The first pair of nippers, or nip-jaws as they are indifferently called, are constructed and operated as follows: Upon the shaft, E, is fixed the arm, E^1, which carries and operates the lower jaw, E^2, of the nipper. Upon the shaft, E, is loosely fitted a tube, F^2, which has an action independent of the shaft, E; and the top joint of the first pair of nippers is secured by the spring arm, F^1, to this tube, as shown. The second and the third pair of nippers are constructed in exactly the same manner, as will be easily observed from the illustration. This obviates the necessity of any repetition of the description, and brings us to the revolving comb cylinder, L, which it will be seen from Fig. 3 is driven from the wheel, R, working into the wheel, L^1, keyed upon the shaft, L^2. The two rollers, MM^1, are delivery rollers, the small one upon them being an attaching roller, which secures the material as it comes from the last pair of nippers. The next pair of rollers, OO^1, receive, calender, and deliver the combined fiber to the drawing head, by which it is made into a sliver. From the above description it will be seen that a result equal to double combing can be obtained, as both ends pass over the revolving cylinder comb. The waste which is combed out of the material by the cylinder is carried round until the latter comes into contact with the revolving brush, P, which strips it from the comb, L, and deposits it upon the card cylinder. P^1, from which again it is stripped by the doffer comb, P^2.

Having thus traced the operation of the working parts, the manner in which they are actuated may be seen by Fig. 3. As before stated, to avoid torsion of the shafts and tubes the main gearing is fixed in the middle of the machine, as shown in the perspective view. As the driving parts (seen in Fig. 1) have to operate to both right and left, it will be obvious that most of the parts exhibited in Fig. 3 are duplicated and arranged one behind the other. The swing beam, S, is shown in front of and covering a similar beam on the other side. The duplicate racks, T, are pivoted near the bottom to and are actuated by the swing beams, S, and give motion to the first pair of nip-jaws in the following manner: The rack, T, rests upon and is supported by the small bowls, UU', held in the bracket, U^2. The reciprocating action of the beam, S, is transmitted through the rack, T, to the segment wheel, E^3, keyed upon the shaft, E, and thence to the lower jaw, E^2, of the first pair of nip-jaws. On the opposite side these parts are duplicated, with a corresponding action, which operates the top jaw of the first pair of nippers. The brackets, U^2, and the opposite one are free to oscillate on the tube shaft, F^2, by which the segment wheels, E^3 and F^3, are maintained in gear with their respective racks. The third pair of nip-jaws are actuated by similar means from the swing beams as before. The second pair obtain their motion from the spur wheel, R', secured to the shaft, R^2, to which the hollow cams, WW', are secured or cast. The remainder of the appliances are like those used in the preceding cases.

The shafts to which the lower jaws are secured extend the whole length of the machine, while the tubes carrying the upper jaws are made in sections and are coupled together. The movable roller, N, is actuated by suitable and reliable mechanism. The feed rollers, C, are driven by a pawl and catch wheel, and by an adjustment the pawl is caused to take up one or more teeth, and thus regulate the amount of feed.

Our readers hardly need any assurance that machines proceeding from the establishment of Messrs. Curtis, Sons & Company are well constructed and highly finished. Indeed, the firm, we are informed, was the first to introduce machine cut cams into a combing machine which was exhibited at the Pomona Palace, Manchester, in 1875. These proved to be such a decided improvement that they have since been generally adopted.

The machine, as here shown, is adapted for cotton or silk waste. In silk waste the combed material comes out much cleaner than on the old plan, and lessens the cost of the subsequent processes in getting up to a highly finished state.—*Textile Manufacturer.*

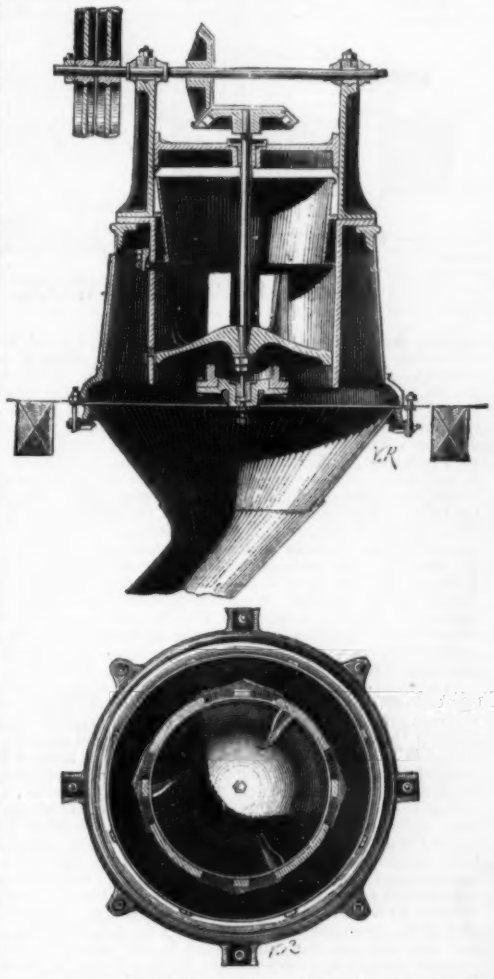


FIGS. 2 AND 3.—THOMPSON & BARKER'S COMBING MACHINES.

BARBET'S CENTRIFUGAL ROOT CUTTER.

THE apparatus represented in the accompanying cut is designed for cutting up beet roots in sugar factories wherein the process of diffusion is employed. It is based upon a very different principle from that of other root cutters. The knife boxes are fixed to a stationary cylinder, against, which the beets are held by centrifugal force.

The beets are introduced into the apparatus at the upper part, and come into contact with arms that are adjusted to a central shaft having a rotary motion, as in a turbine. The beets are carried along by these arms, and, through centrifugal force, are thrown against the side of the stationary drum, where they are cut up by the knives. The pulp obtained is long and regular. It traverses the knife boxes, strikes the external shell of the root cutter tangentially, and afterward falls into the hopper of the distributer. The beets disappear in measure as they arrive, and thus leave the vat



BARBET'S CENTRIFUGAL ROOT CUTTER.

of the apparatus always clean. The number of knife boxes varies according to the production that it is desired to obtain. They are grouped in twos and threes, and opposite each group there is a door that permits of putting in place, inspecting, or taking out the knives with the greatest facility.

While in operation, it is only necessary to open these doors in succession in order to ascertain the delivery of each knife box in particular, and thus find out whether it is properly regulated. If it were found that one of them was producing pulp that was either too coarse or too fine, this box would be replaced isolatedly.

The mode of regulating the boxes is a very convenient one, as well as new and ingenious.

If the knives chance to become clogged with filaments, it is easy to disengage them therefrom by revolving the apparatus in an opposite direction. The cleaning is thus performed mechanically, and permits of going ahead again without changing the boxes.

In this apparatus the cut is rectilinear, and the velocity with which the cutting is done is uniform at every point. Upon escaping, the pulp meets the side of the shell at such an angle that it cannot break. The sides of the shell slope slightly, so as to prevent any adherence of the material, which latter falls by its own weight without requiring the use of an apparatus to gather it up.

As a consequence of the parallelism of the knife boxes, and of their grouping, the pulp takes a very uniform profile. If triangular blades are used, its section throughout its entire length will be that of a very regular V. In apparatus of this kind an endeavor should be made to reduce the cutting angle to a minimum. With this end in view some constructors have employed special knives that were folded or bent in a peculiar way; but, in the apparatus under consideration, ordinary flat knives permit of the same result

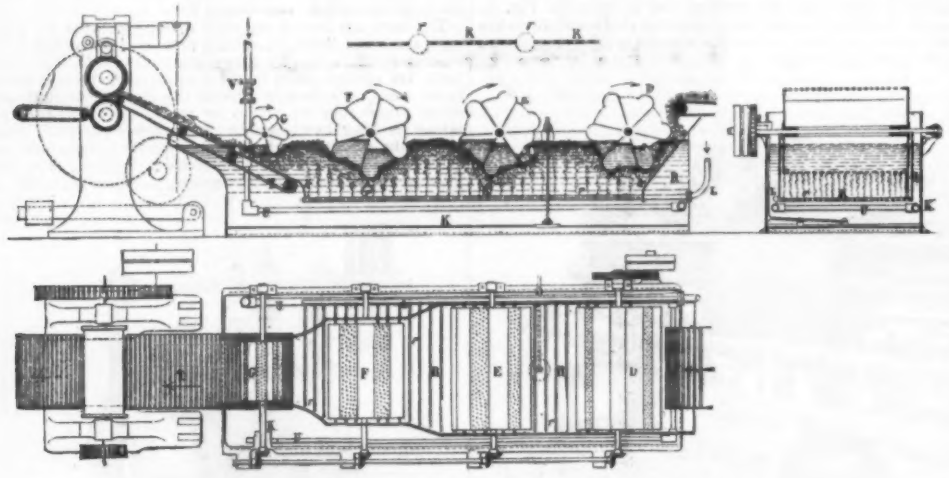
being reached. It is due to the curvature of the cylinder that the blades are upon a plane nearly tangential to the circumference.

This apparatus is capable of cutting up 360,000 to 400,000 kilos of beets per day, and requires but a small amount of power to run it.—*Revue Industrielle.*

MEHL'S WOOL WASHING MACHINE.

The operation of a machine for washing wool may be divided into four parts: (1) the immersion of the wool in the water; (2) division and washing of the wool; (3) forward motion of the wool in the water; and (4) carriage of the wool to the cylinders of the press which succeeds the washing machine. Mr. Mehl, of Augsburg, employs for this work two combined means—introduction of air into the washing water, and use of immersed drums and motors of special structure. In this way there is obtained a completer washing of the wool, and the fibers are kept as parallel as possible.

Mr. Mehl's apparatus, which is represented in the accompanying figures, consists of a large rectangular vessel, K, containing a small vat, *k*, in which the washing is effected. A grating, R, of perforated iron plate is placed in the vat, *k*, and is traversed by a certain number of tubes, *r*, which debouch at one of their extremities into the principal pipe, L, and are closed at the other end by a screw. These small tubes, *r*, are provided with regularly distributed apertures from one to two millimeters wide. Hot air is forced, by means of air pump or steam jet apparatus, into the pipe L, and from thence, through the tubes, *r*, into the water in the vat, *k*, throughout the entire surface of the grating. The apertures in the grating R, and the interstices in the discharging table, T, constitute the passages that establish a communication between the water in the two vats, K and *k*. The object of having a double vat is to render it possible to dispose of as large a quantity of water as possible, to keep the wool as united as possible on its entering the water, and to gather it together gently upon the width of the discharging table, T, as a consequence of the progressive approaching of the two sides.



IMPROVED WOOL WASHING MACHINE.

In order to obtain a regular movement forward of the wool, the rakes usually employed are replaced by four drums, D, E, F, and G, which are all arranged in the same manner and differ from one another only in their length and diameter. Each of these consists of a hollow cylinder whose interior is divided into six compartments, and upon whose periphery there are six semi-cylindrical projections. These latter, as well as the ends of the drums and the partitions, are of sheet iron, while all the parts of the circumference comprised between the projections are of perforated sheet iron. The interior partitions are arranged with respect to the direction of revolution of the drums in such a way that, at the moment a projection enters the water, the chamber at this point shall contain no water. As soon as the succeeding perforated part of the drum enters the water, the latter enters the drum, and gradually fills the empty space in the chamber. The number of small apertures (each of from 2 to 3 mm.) is chosen in such a way that the chamber may be filled when the corresponding projection has reached its lowest position in the water. From such position, up to the exit of the projection from the water, the chamber empties itself anew.

The back drums, D and E, have the same length, but G is a little shorter than the discharging table, T, and the length of F is intermediate between that of E and G. By means of conical gearings, all the drums are made to revolve with a velocity perceptibly equal to that of the table, T.

When the apparatus is to be operated, the vats, K and *k*, are first filled with washing water. The machine is then started, and the hot air forced into the pipe, L, makes its exit through all the tubes, *r*, of the grating, rises to the surface of the water, and gives the latter a slight undulatory motion. The wool to be washed falls behind the drum, D, in the interior vat, *k*, and, by means of the water that enters the drum, is gently pressed against the perforated portion, *s*; and the projection which succeeds immerses it in the water, and causes it to move beyond the lowest point of the drum, D. The water that issues from the latter then begins to detach the wool from it, and the ascending air carries along the fiber to the surface of the water, and communicates to it in doing so an undulatory motion that rapidly opens it and frees it from all adhering impurities. The wool gathers upon the surface of the water, and increases in quantity as far as to the drum, E. The same operation occurs for a second and third time, and then the material accumulated between the drums, F and G, is pushed by the latter up to the table, T, which carries it gently and regularly out of the water toward the cylinders of the press.

From what precedes, it results that Mr. Mehl's apparatus offers the following advantages over its predecessors: a rapid cleansing, with a considerable saving in soap; a complete opening of the wool, so that it presents no felted portions; and the keeping of the water hot by means of heated air continuously forced into the machine. This latter feature permits of an uninterrupted running of the apparatus, in causing a constant entrance of pure water at the table end, A B, each tuyere is provided with a shut-off valve. These valves have their plugs connected together by pitch chains, and are operated simultaneously by one handle. The rows of tuyeres are all inclosed in a circular belt, and opposite each tuyere is a cover provided with a colored mica disk. The cupola is arched over at the top, G, and has an opening, H, fitted with a damper-door for the escape of the gases. It stands upon a cast-iron plate on four pillars, and is provided with a drop bottom. In the front there is fixed a receiver, provided with a spout, and large enough to hold a very considerable quantity of melted iron. The stand pipes, I I, to convey the blast from the blower, are two in number, one on each side. The receiver is also connected with the pipe, K, and ejector valves, M, in order to draw the surplus or waste heat from it and force it into the tuyere chamber; and by a simple arrangement of the ejector valve, M, the blast can be turned into the receiver at or below the surface of the metal, to refine the iron.

It is claimed for this cupola that it melts its charge rapidly, with the minimum quantity of fuel, and is not more expensive than the usual construction. There is an absence of flame at the top, carbonic acid gas alone escaping, without any combustible gases; and the work is done with great regularity and little trouble at the tuyeres.

These cupolas are made of melting capacities from one ton to twenty tons per hour. That shown in our illustration is of about four tons capacity per hour, and takes a bed of coke of about 4 cwt.; whereas in ordinary furnaces about 13 cwt. is the usual bed charge, thus giving an advantage of about 9 cwt. of bed coke.

Its approximate dimensions are as follows: External diameter of shell, 4 ft.; total height from ground line, 24 ft.; height from ground line to under side of air belt, 5 ft.; depth of air belt, 2 ft. 6 in.; diameter of air belt, 5 ft. 6 in.; melting part of cupola, 3 ft. 6 in. deep and 1 ft. 10 in. diameter, widening out to an internal diameter of 3 ft. in the upper portion; thickness of lining at melting part, 1 ft. 1 in., upper portion, 4½ in.; internal diameter of receiver, 3 ft., and depth 3 ft.; height of tapping hole from ground line, 2 ft. 3 in.

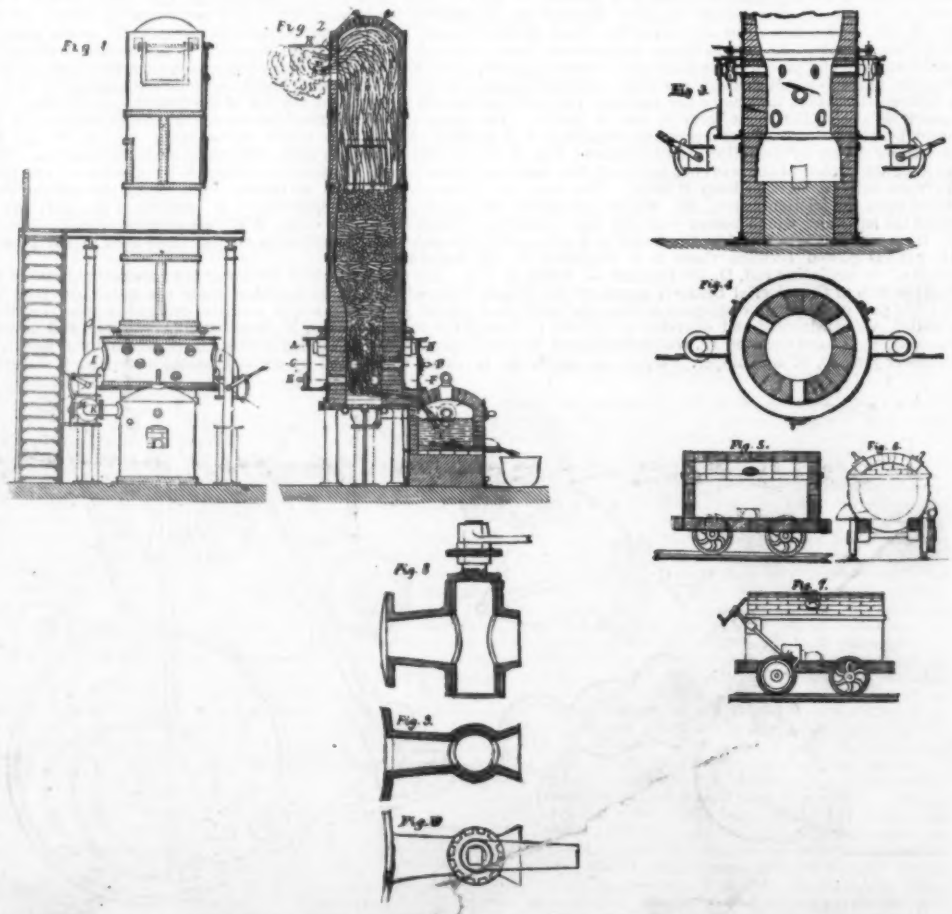
Figs. 3 and 4 show a vertical section and plan of a cupola with the space for the melted metal inside and near the base in the ordinary manner. The arrangement of tuyeres, air belt, valves, etc., is the same as with an external receiver, with the exception of the ejector valve, which is not necessary in this case. The base of the cupola is securely fixed to a cast bed-plate. The engraving shows the upper portion of the cupola wanting from the first joint above the air belt, as Messrs. Thwaites Brothers find it convenient in some cases to supply them in this form, in order to render them easy of transport, and the purchaser can complete them to his requirements.

In practice a narrow gauge line of rails, 15 in. wide, is used for rapidly and conveniently conveying the molten metal from these cupolas to any required mould by means of portable receivers, one of which is shown in Figs. 5, 6, and 7. It consists of a wrought-iron casing, firebrick lined, and mounted on a neat angle-iron frame, supported and carried on flanged wheels of the same gauge as the portable rails laid round the foundry. To one axle of the carriage is fixed a wormwheel actuated by a worm and handwheel, to permit of the easy transit of the receiver by hand, and to prevent its movement, etc., while the metal is being discharged. This receiver is also fitted with a spout for tapping, and with two plugged holes, one on each side of the arched cover, for charging and for the escape of gases. The advantage of these portable receivers is that any number of them can be used in running large castings, without interfering with the ordinary work of the overhead traveling crane.

Figs. 8, 9, 10, and 11 are illustrations of the small valve fixed inside the air belt of the cupola, for the purpose of regulating the ingress of the blast through the top row of tuyeres to the upper zone of fusion in the melting part of the cupola, A B, Fig. 2. These valves are generally brought into operation when blowing the charge down.—*Engineering.*

VINCENT'S APPARATUS FOR THE PRODUCTION OF COLD.

Since the year 1856, the epoch at which Mr. F. Carre made known his sulphuric ether machines for the artificial production of cold, which were soon followed by his ammonia gas machines, other similar apparatus have been devised and applied with more or less success. All of them, excepting the compressed air machines of Giffard & Berger, are based upon the application of volatile liquids which boil at low temperatures, the vapors of which are taken up through absorption or mechanical suction and compression, the result being the liquefaction of a gas. In this form came the methylic ether machines of Mr. Tellier and the anhydrous sulphurous acid machines of Mr. Pictet. A young engineer, professor of

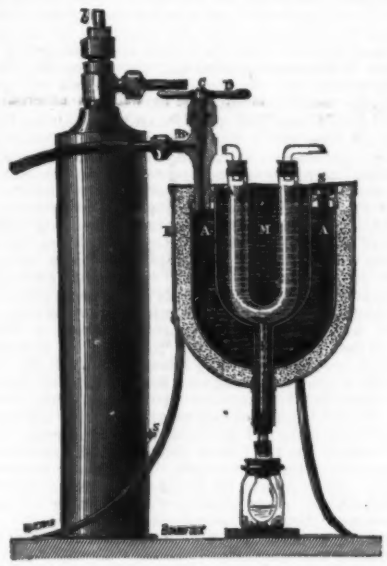


IMPROVED CUPOLA AND RECEIVER.

chemistry at the Central School at Paris, Mr. C. Vincent, a few years ago made an application of the peculiar properties of chloride of methyl (which does not attack metals, and the vapor of which is respirable without danger) for obtaining low temperatures. His machine for making ice artificially by this means we have already illustrated and described.

The accompanying cut illustrates another of Mr. Vincent's apparatus, which he has named a *frigorifère*. The two spherical bottomed cylinders, A M, are placed one within the other and connected with each other by their bottoms and upper edges in such a way as to form a space, A, which is protected externally by an isolating jacket, E. In the reservoir, M, which is full of a non-freezing liquid, is placed the apparatus that serves for the experiments—for example, a tube, V, traversed by the gas to be liquefied and provided with a branch for leading the liquefied gas to a receptacle beneath.

The chloride of methyl is stored up in a portable cylinder,



VINCENT'S APPARATUS FOR THE PRODUCTION OF COLD.

P, which is provided with a cock whose tube is connected by means of strong rubber tubing with the tube of a like cock placed above the annular space, A. The screw plug, S, when slightly unscrewed, permits of letting out the air as soon as the chlorine vapor, through the opening of the cocks, enters the space, A, and produces therein a temperature of —25°. On producing a vacuum in the space, A, the temperature may be reduced to —50°. Upon forcing the gas into a tubular apparatus surrounded with cold water, it will become liquefied and thus be rendered fitted for beginning a new operation with.

This simple apparatus ought to prove especially useful and convenient for laboratory experimentation.—*Chronique Industrielle.*

GAS INJECTOR FOR BLOWING SOAP BUBBLES.

THE apparatus shown in the accompanying cuts permits of blowing soap bubbles filled with smoke, without taking the latter into the mouth; but it offers an additional interest that is of more importance, since, from a scientific standpoint, it constitutes a true gas injector of a new class. According to the inventor, who has put upon the market the model that seemed to him the simplest and most practical, the apparatus may be constructed in several ways. The one which we have examined, and which is exposed for sale by toy dealers, under the name of "Bob's Pipe," consists of two concentric tubes, A and BC (Fig. 1), held one within the

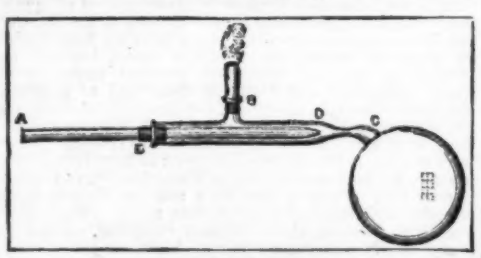


FIG. 1.

other by means of a pierced rubber stopper, E, thus permitting of its being regulated and cleaned. The internal tube, A, conducts the current of air blown by the operator, and, through its tapering extremity, projects the current to the interior of the second tube, BC, within which it is inclosed. The air contained in the large tube, BC, is then carried along by the current, and mixes therewith. The mixture issues from the external tube through a conduit which first contracts and then expands in the shape of a cornucopia, C. This expanded extremity, C, having previously been dipped into a solution of soap, serves to form the bubble.

It is evident that if the external tube is provided, in addition to this exit orifice, with only one aperture, into which a lighted cigarette is inserted, the smoke from the latter will be drawn into the tube as a consequence of the depression produced therein, and will make its exit mixed. The mode of using the apparatus is clearly shown in Fig. 2.

The cigarette is lighted, not by suction, but by blowing into the tube as it is held in the mouth. As we have before stated, the smoke does not enter the operator's mouth. The proportions of smoke and air vary according to the relative position of the tubes, the velocity of the motive current, the ratio of the sections of the orifices, and many other things that it would take too long to give a mathematical analysis of. All injectors are based upon that of Giffard. The apparatus which made him celebrated, and gave him his fortune, carries along a liquid by means of a current of steam.

The vaporizer, which carries along a liquid by a current of air or steam, is another sort of injector, and one which is sold everywhere for perfuming apartments and for medical uses. The draught of locomotives is obtained by an injector. A current of steam carries along the gaseous products of combustion, and produces in the smokestack a vacuum which sucks the external air into the fireplace in order to urge the fire. In certain blast furnaces a jet of steam is used to force the air into reservoirs. The steam comes into contact in the latter with cold wet coke, and condenses, and the air alone goes to the fireplace. These injectors are of the same class as those of locomotives.

Finally, the Bob's Pipe, the youngest of injectors, belongs to a new class, of which it appears to be the sole representative. A current of cold air carries along the products of the combustion of a body—the smoke of the cigarette.

The apparatus under consideration is not only a plaything to form soap bubbles with, but is also a physical apparatus

FIG. 2.

for the study, *de visu*, of the operation of gas injectors; and it is for this reason that we devote this article to it. It seems that it was for such a study, too, that its inventor constructed it.—*La Nature.*

THE MANUFACTURE OF GAS FROM LIMED COAL.*

By J. ALFRED WANKLYN.

ALTHOUGH the distillation of coal in the process of gas-making forms the chief source of the ammonia of commerce, it is a well ascertained fact that only a small fraction of the total nitrogen of coal is made to assume the form of ammonia in the process of gas-making, as commonly carried out. From the great importance of an abundant supply of ammoniacal salts in agriculture, the economizing of a larger proportion of the nitrogen of coal becomes a matter of national concern; and the introduction into the gas industry of a process which renders useful a larger fraction of the nitrogen in coal ought to meet with a hearty welcome at the hands of all who are interested in the prosperity of agriculture.

Such a process is Cooper's plan of liming coal as a preliminary to distillation in the gas retorts. The following quotation from the specification, which is dated June 2, 1882, will serve to indicate the nature of the process:

"To the coal, either in a lumpy condition (such as that in which coal is used in gas-making), or, by preference, in a state of fine division, I add lime in the condition of hydrate of lime, or slaked lime, and I cause the mixture to be well incorporated. When I employ the mixture in gas retorts in gas works, I find it convenient to employ about half a hundredweight of quicklime to every ton of coal, and I slake the lime with about its own weight of weight of water (*i. e.*, five gallons of water), whereby it is brought into such condition to be as readily mixed with the coal."

From this quotation it will be seen that Cooper proposes to make gas from a new gas-generating material, which may be appropriately designated "limed coal."

The products which arise in the distillation "of limed coal" differ materially from those given in the ordinary course of gas manufacture by distilling coal pure and simple.

Limed coal yields a larger fraction of its nitrogen in the form of ammonia; a slightly larger fraction of its carbon in the form of volatile compounds (*i. e.*, there is an increase in the tar and gas taken conjointly); a smaller fraction of its sulphur in volatile forms; and it yields limed coke instead of common coke.

Here is a specimen of limed coke from the Tunbridge Wells gas works, where the new process has been in operation for the last three months. As you will perceive, there are hardly any physical difference between limed coke and common gas-coke; an occasional white speck, where the lime has failed to mix perfectly with the coal, being the only apparent distinguishing feature. The differences show themselves when the coke is burnt.

Common coke, as most persons know by experience, gives off very abundantly the pungent fumes of sulphurous acid when it is burnt. Limed coke, on the other hand, evolves very little sulphurous acid on combustion, and, granting that the original admixture of lime and coal was absolutely perfect, would evolve absolutely no sulphurous acid.

The limed coke has another advantage, and that advantage was quite unexpected when the investigation of Cooper's process was begun in the laboratory before the filing of the specification. Inasmuch as lime, and calcium compounds generally, are pre-eminently non-volatile, the addition of lime to the coal before distillation must be equivalent to the addition of so much mineral matters to the ash of the coke given by the coal. Limed coke, manufactured from a given quality of coal, must necessarily contain more fixed matter or ash than common coke from the same quality of coal. We dislike fuel which leaves much ash; and, indeed, ash in fuel is recognized as not only unprofitable but "profligate"—to borrow a term from agricultural chemistry. It was anticipated, therefore, that limed coke would not burn so well as common coke. This anticipation has been negatived. A very large quantity of limed coke has been produced and burned under a great variety of circumstances, and it has been observed that the limed coke burns brighter, and quicker, and readier than common coke. And when we seek for an explanation, we are led to see a potent oxygen carrier in the thin film of calcium compound, which coats the coke as it is gradually burnt away in the fire. Especially is limed coke adapted for domestic consumption in dwelling houses.

Limed coal yields a larger fraction of its nitrogen in the form of ammonia. In order to gain a proper idea of the actual production of ammonia in the gas industry, the records of the London gas works may be consulted with advantage. In the aggregate, the London gas works carbonize upward of two million tons of coal annually, and obtain from 5 to 6 lb. of ammonia from each ton of coal.

If all the nitrogen in the coal were got into the form of ammonia, the yield of ammonia would be from 25 to 50 lb. of ammonia per ton of coal carbonized. The production of coke appears to be incompatible with the complete transformation of the nitrogen into ammonia, for coke contains a solid carburet of nitrogen, endowed with great stability, and resolvable into ammonia only when the coke is made to assume the gaseous form, by combination with oxygen and hydrogen.

Cooper's process increases the yield of ammonia very considerably, without making a sacrifice of the coke. Experiments made in my laboratory on the yield of ammonia by Cooper's process show that the ton of coal may be made to give from 12 to 15 lb. of ammonia, when it is limed, upon being distilled. And I look for a similar result in practice on the large scale, not immediately but in course of time.

A substantial gain in ammonia, due to the liming process, has been shown by the following engineers: Mr. Trewby, at Becton; Mr. Jones, at the Commercial Gas Works; Mr. Paterson, at Cheltenham; Mr. Wilton, at Silvertown; Mr. Eastwood, at Batley; Mr. Botley, at Wormwood Scrubbs; and Mr. Dougall, at Tunbridge Wells. The highest comparative yield, *i. e.*, the greatest difference between the same sample of coal in its limed and its unlimed condition, has been shown by Mr. Botley, at Wormwood Scrubbs. Mr. Botley showed that, in his experiment, the yield of ammonia was doubled when the coal was limed. The highest absolute yield of ammonia has been shown by Mr. Dougall, at Tunbridge Wells.

In the course of these trials, which have been going on during the last eighteen months, I have been strongly impressed with the inadequacy of the arrangements for the collection and storage of the gas liquor in most gas works, and especially in old gas works. At the old Bankside Works, belonging to the South Metropolitan Gas Company, no gain of ammonia was registered. At the Vauxhall Works, another branch of the South Metropolitan Gas Company, there was no gain of ammonia, and yet some 30,000 tons of coal had been limed. I entertain no doubt whatsoever that the failure to get the gain of ammonia depended on the bad arrangements which prevail at those works.

(2.) The slight increase in the fraction of the carbon which assumes the volatile condition when limed coal is distilled has been dealt with on a recent occasion, and I will pass it over without further mention.

(3.) The great diminution of the fraction of the sulphur which assumes the volatile condition when "limed coal" is distilled will now engage our attention.

Chemists are quite familiar with the fact that sulphur present in organic compounds can be caused to attach itself firmly to calcium, by simply heating the organic compound in contact with lime; and, in accordance with general chemical principles, a perfect mixture of coal with excess of lime cannot possibly evolve sulphur compounds when it is heated strongly. It will, therefore, be intelligible that limed coal should yield little or no volatile sulphur compounds when it is employed in gas-making.

In a preliminary experiment, in which gas was made from limed coal in the laboratory, so striking was the absence of sulphur compounds from the gas, that the patentee recognized the gas as being fragrant rather than fetid, as is the case with common crude gas. Sulphur, as is well known, occurs in crude-coal gas partly and mainly in the form of sulphureted hydrogen, and partly in the form of what is by gas managers termed "sulphur," or "sulphur compounds other than sulphureted hydrogen." These sulphur compounds consist of bisulphuret of carbon and a variety of other volatile sulphur compounds which are little understood.

As has been said, the main portion of the sulphur exists as sulphureted hydrogen. I have found from 0·8 to 1·5 vols. of sulphureted hydrogen in different samples of common crude-coal gas. The "sulphur other than sulphureted hydrogen" in common crude-coal gas, as far as I have been able to ascertain, is less than 0·3 vols. per 100 vols of gas.

Both the sulphureted hydrogen and the "sulphur compounds other than sulphureted hydrogen" are diminished by the application of Cooper's process. Even when Cooper's process is very imperfectly carried out, that is to say, when the mixing of the lime with the coal is very imperfect, the diminution of the sulphur in the crude gas has been observed.

* A paper read before the Society of Arts, London.

Thus, for instance, at the Vauxhall gas works, where the coal has been very imperfectly limed, the following observations were recorded in January, 1883:

Vols. of sulphureted hydrogen in 100 vols. of crude gas from:

		Limed coal.	Unlimed coal.
Experiment	I.	0·42	0·61
"	II.	0·45	0·61
"	III.	0·42	0·58
"	Mean	0·43	0·60

In addition to the evidence of the diminution of H_2S afforded by examination of the gas itself, there is other and equally conclusive evidence afforded by the prolongation of the time during which purifiers retain their activity. Thus, at Tunbridge Wells, the duration of the active life of an oxide of iron purifier has extended so that a life of ten days has been prolonged to much more than fifty days. In fine, this diminution of the sulphureted hydrogen by Cooper's process is so palpable that it cannot be overlooked. Equally certain is the diminution of the "sulphur compounds other than sulphureted hydrogen," and the diminution is palpable, even in cases when the mixing of lime and coal has been very imperfect.

At the Vauxhall gas works there were, in the early part of last year, supplies of crude gas from limed coal in one retort house, and of crude gas from unlimed coal in another retort house. Comparative testings of the gas were made with the following results:

1883.		Limed.	Unlimed.
30th January	I.	14·4	26·3
"	II.	17·1	26·3
"	III.	15·9	—
31st "	I.	16·4	26·3
"	II.	17·2	27·9
"	III.	16·8	—
1st February	I.	16·8	25·6
"	II.	11·2	18·0
2d "	I.	16·1	26·3
"	II.	16·4	27·0
3d "	I.	15·6	25·4
"	II.	15·4	25·0
5th "	I.	14·1	27·1
"	II.	17·3	—
6th "	—	15·3	27·8
7th "	I.	19·7	29·5
"	II.	17·4	29·4
8th "	I.	16·4	28·2
"	II.	17·6	26·1
"	III.	20·5	—
9th "	—	16·7	24·1
10th "	I.	13·6	23·5
"	II.	15·3	—
12th "	I.	12·8	16·7
"	II.	15·0	11·2
"	III.	11·8	15·2
"	IV.	18·0	15·2
"	V.	—	21·7
13th "	I.	13·7	18·9
"	II.	12·8	21·2
"	III.	13·0	21·0
"	IV.	10·3	19·4
"	V.	10·6	—

On the 14th February, 1883, all three retort houses at Vauxhall were placed under Cooper's system, and there was no gas from unlimed coal at the Vauxhall works, and the comparative testing came naturally to an end. In the above investigation the circumstances of the case precluded the employment of the Referee's method, and Harcourt's method had to be resorted to. Each figure in the above statement is the mean of some four or five readings.

After 15th February, when all the gas at the works was made from Cooper's limed coal, a pipe from the main in one of the retort houses was caused to convey a portion of the crude gas to a small condenser, and then the gas went through a scrubber, and then through three boxes charged only with oxide of iron, and then it was collected in a small holder, which was filled every day. The gas was tested by the Referee's method, and gave the following results:

1883.	Grains of S. per 100 cubic feet of gas.
20th February	11·8
21st "	13·5
22d "	12·2
23d "	13·2
24th "	13·6

On 26th February very little lime was added to the coal, next day no lime was mixed with the coal, and Cooper's process was stopped till 5th March, when it was recommenced, and continued for many weeks.

Continuing the tabular statement, the figures were as follows:

28th February	24·5
1st March	31·0
3d "	18·2
6th "	24·4
7th "	12·4
8th "	8·0
10th "	3·3

The amount of coal carbonized at that time at Vauxhall amounted to about 3,000 tons a week; and the success of the process was so manifest, that even the officials of the South Metropolitan Gas Company were moved, and on March 9th, on the occasion of the emptying of one of the large lime purifiers at the Vauxhall works, the opportunity was seized to substitute oxide of iron for the lime. About a week later, a second lime purifier was refilled with oxide of iron, and on March 24, a third lime purifier was charged with oxide of iron, and from that time forward, for a considerable period, no lime other than that employed in the Cooper process was used at Vauxhall.

As I have already mentioned, the liming of coal, as carried out at Vauxhall, was very irregular and imperfect. Since that time, Cooper's process has been put in operation under less unfavorable conditions. By the aid of the admirable machine which the gas industry owes to Mr. West, a good and regular admixture of the lime with the coal has become practicable, and at the Tunbridge Wells gas works—notwithstanding that the coal is rather highly sulphurous, containing 1·7 per cent. of sulphur—an average of 3·0 grains of sulphur per 100 cubic feet of gas has been maintained for three weeks. Not only has the lime purifier been abolished at Tunbridge Wells, but so altered is the function of the oxide of iron, that the manufacture of gas in Tunbridge Wells has been correctly designated by Mr. Spice as an operation in closed vessels.

With the sulphur reduced to 3 grains per 100 cubic feet of coal gas, and with purifiers which require changing only once or twice a year, the gas industry enters upon a new era.

In dealing with the financial side of the liming process, I have first to direct attention to an almost unique feature which distinguishes this process from what is usually brought before the gas industry. No new plant is required, but, on the contrary, plant is diminished. Neither is any new material brought into the gas works, for lime has been there ever since the gas manufacture began. Computing on the one ton of coal carbonized, as is customary among gas-makers, the cost of the lime itself, and the slaking of it, and its application to the coal, is about 6d. per ton of coal carbonized. A small allowance for extra retort room has to be made, for a ton of coal without lime gives practically about the same quantity of gas as a ton of coal with lime. This allowance is 2d. The debit side of the account is therefore 8d.

On the credit side there are a variety of items. First of all, the cost of the lime is, to a great extent, recovered when the coke is sold. The presence of the lime in the coke, as has been explained, is useful. And buyers of coke have already acknowledged the utility of the lime in the coke by paying for it. The saving in the cost of gas purification is a most important item. There is a saving of 90 per cent. in labor, and almost an entire saving of the purifying material. The saving in purification may be set down at 7d. Then there is the gain in ammonia, 9d., and the gain in tar, 2d. On these items alone there is a balance of one shilling per ton of coal carbonized. This is a very moderate estimate, and at Tunbridge Wells gas works has been greatly exceeded.

Besides the above advantages, which are immediate and on the surface, there are other advantages. The saving in purifying plant is a very great advantage. Many gas works are in great straits, by reason of the inadequacy of the purifying plant to meet the requirements of the winter make of gas. In these instances, the adoption of the liming process is a vital matter. The question of the abatement of nuisance has a financial aspect, and the possibility of doing away with the lime purifier will enable many a gas works to continue in existence in the midst of a dense population.

I have, at the Southport meeting of the British Association, called attention to the sanitary aspect of this subject. To stop the pollution of the general atmosphere with sulphurous acid is, briefly, that which the adoption of the liming process will achieve. To accomplish that, is to bring back vegetation into our towns, and to remove one of those general agencies which tend to depress the vital energy of the population.

By the production of an illuminating gas of unprecedented freedom from sulphur, the liming process will greatly benefit the gas consumer in his home. Gas, as hitherto known, has been one of the most destructive agents which has ever entered our houses. Gas practically free from sulphur, that is to say, gas such as the liming process furnishes, will cease to be destructive, and will become as harmless as the electric light itself.

During the discussion Prof. Wanklyn said further it was a marvel to him, from what he saw of the liming which took place at Liverpool, how any result whatever could be obtained. The coal, instead of being the usual mixture of lumpy and small coal, was in large blocks, 40 per cent. to 60 per cent. being cannel. The mixing performed was of the most rudimentary kind, and it spoke very highly for the process that, under those conditions, the gain in ammonia was so marked that Mr. King could not fail to recognize it. The lowering of the sulphur compounds was also very marked, and, as he had been informed, Mr. King wrote to Mr. Livesey, saying that they had solved the sulphur problem. That occurred soon after the introduction of the process. With regard to the destruction of the furnace bars when the process first came out, no one could possibly have felt more keenly than he did that they would have to contend with almost insuperable prejudices, that it would be said that the coke was spoilt and everything destroyed. Now, at Vauxhall, the process was put on to one of the retort houses in January, and continued up to June, about 1,000 tons of coal being carbonized weekly, and no damage had occurred to the furnaces that he had heard of. If it damaged the furnaces in one place, it should in another. No damage either was done at Tunbridge Wells; but this immense damage was done in Liverpool. No doubt this depended upon the peculiarities in the way the work was carried on. Mr. Harris had asked what they did with the carbonic acid? Now, the use of lime in the retort did not diminish the proportion of carbonic acid which came out with the gas, but the extra ammonia which was formed absorbed some of it, and practically, in the gas as it left the purifiers, there was a smaller amount of carbonic acid. In the ordinary process, as conducted in London, the carbonic acid was taken out, not because it did no direct harm, but because it must be removed before you could use lime so as to lower the sulphur compounds. When carbonic acid occurred in considerable quantity, it was worth taking out, but traces of it were not, as there was no process by which you could take them out which would not itself lower the illuminating power of the gas to as great an extent as the carbonic acid itself. He was afraid he had not made himself quite clear with regard to the improvements claimed for this process. It was claimed that they, in one sense, abolished all purifiers whatever; that only the oxide of iron required to be used, and that the purifier need only be opened once or twice a year, just as a scrubber had to be opened occasionally; the lime purifiers disappeared altogether, and the oxide of iron lasted so long that the process became one of work in closed vessels. There was a very beautiful theoretical explanation of the fact. The gas, as it left the retort, contained 0·4 of sulphureted hydrogen, and one per cent. of air entering the gas would give sufficient oxygen to consume that sulphureted hydrogen. What was really done in this process, when properly carried out, was to make use of the traces of air which entered, and practically to do all the purification by means of that trace of air. The oxide of iron purifier became a sulphuret of iron sponge, the function of which was to transfer oxygen from the traces of air to the sulphureted hydrogen. That was why the process was one of operating in closed vessels. A question had been asked about the adhesion of sulphur to calcium. One of the prejudices he knew they would have to deal with arose from the well-known fact that the contents of the lime purifiers, when taken out and exposed to the air, evolved sulphureted hydrogen. That sulphureted hydrogen did not come from sulphate of calcium, but from a compound of sulphuret of calcium with sulphureted hydrogen. That sulphuret of calcium adhered to the sulphureted hydrogen, but when the compound became heated by oxidation, the sulphureted hydrogen parted company with the sulphuret of calcium; but really sulphuret of calcium in the presence of an excess of lime did not part with its sulphur. So certain was this adhesion of sulphur to calcium, that you might actually measure the amount of sulphur in coal by taking powdered coal, weighing it, mixing it with about half its weight of slaked lime, and then igniting in a platinum crucible. In that way you got sulphate of lime, which you could wash off and convert into sulphate of baryta. He had determined the amount of sulphur in coal in that way, which seemed to him an absolute proof of the perfect manner in which sulphur and calcium held together.

KEROSENE—ORIGIN OF THE NAME.

As early as 1739, there appears in the records of the Royal Society of London, in an account of the experiments of Dr. Clayton, the statement that, in the distillation of coal for gas, there appeared a black oil, which, however, was not examined closely, gas being the object of interest. In 1781, the Earl of Dundonald obtained a patent in England for distilling coal for gas, and in 1805 Mr. Northern, of Leeds, England, mentions oil as resulting from coal distillation. Laurent and Reichenbach noticed and wrote upon the oils from coal by distillation. In France, Selligue first distilled the bituminous schists of Autun for burning fluids. Mansfield, in 1847, patented in England his mode of obtaining the volatile liquids from tar for dissolving rubber. In the same year Dr. Abraham Gesner, in treating the pitch of Trinidad, obtained various products, and burned them in lamps at one of his lectures at Halifax, Nova Scotia, and at Charlottetown, Prince Edward's Island. The Earl of Dundonald, at that time admiral on the North American station, and at Halifax a part of the time, afforded Dr. Gesner facilities for experimenting with the pitch of Trinidad, he being owner of a portion of the great Pitch Lake of that island, and interested, as may be supposed, in the results of the distillation of bituminous substances. Numerous patents followed that of Dundonald, who again, in 1852, obtained patents in England, some of them based directly or partly on oil making from coal and coal tar. In 1850, James Young, of Manchester, obtained a patent in England for paraffine oil, naming it from the solid hydrocarbon "paraffine" usually found in coal. He used Boghead coal principally, and began the industry in that country four years after. Dr. Gesner patented "kerosene oil" in the United States in 1854, and in 1856 obtained a patent for improvements in its manufacture. The writer, a near relative of the patentee, recalls the debate upon the name to be given to the new illuminating oil, and the reason why "kerosene" was decided upon.

Paraffine, which occurred in the manufacture, has a waxy appearance, and was formerly called "tar wax," and it was suggested that Greek words which signified "wax oil" might form a proper name. Therefore *keros*, wax, and *elain*, oil, were chosen. At that time, camphene, a compound of alcohol and spirits of turpentine, was in use as an illuminator, and it was decided to adopt its termination, the public being familiar with it, and accordingly *Kerosene* instead of *Keroselain* was decided upon. The patentee used the word to distinguish certain portions of the distillate from coal also. The name "paraffine" has a much less fanciful origin; but kerosene has kept its place in popular use, being applied to all kinds of mineral illuminating oils, and has passed into the language through the dictionary since it was originated thirty years ago. The first kerosene or oil distilled from coal in this country was made in 1854 by Dr. Gesner at the works of the New York Kerosene Oil Company, at a place now called Blissville, near Penny Bridge, on Newtown Creek, Long Island. The coal used was a certain description of cannel from Dorchester, New Brunswick. It was low in yield, but produced a fair burning oil. The chemicals used, oil of vitriol and caustic soda, came from the works of Martin Kalbfleisch, at Bushwick; Stillman & Allen (the Novelty Iron Works) supplying the apparatus. The agents of the company were Messrs. John H. Austin and George W. Austin, and they disposed of the oil at their place of business in Beaver Street, near Delmonico's corner.

The new illuminating oil met with the strongest opposition from the turpentine and alcohol trades. Its odor, which was not then so well removed as it was later on, gave those interested a weapon against its introduction, which at times seemed likely to be wielded fatally. After a time, however, its soft, steady light and perfect safety, in contrast with the poor light and fiery rays of camphene, gained it friends and enabled its manufacturers to make headway against all opposition. Mr. John H. Austin greatly assisted in the introduction of kerosene into common use by bringing from Europe an improved burner, the "Vienna burner," which has formed the basis of numberless so-called improvements since. Camphene and "burning fluid" had to give way, and by the time that petroleum, the discovery of which was led up to by coal oil distillation, appeared in large volume, there were fifty-six coal oil works in this country. There were thirteen in Pennsylvania, thirteen in New York, twelve in Ohio, ten in Kentucky, six in Massachusetts, and two in Connecticut. Those in New York and the Eastern States brought their material from various mines. Those in the other States named, almost without exception, worked the cannel coal of seams near at hand. There are yet to be seen the ruins of coal oil works in the States of Ohio and Kentucky, and their neighbors, probably. These works, like those of the seaboard, made no stand against the wave of petroleum which swept over them. They could do so now if they were alive. Between 1854 and 1860, a large number of "experts" in coal oil appeared, and in the States named and around the cannel coal regions, were as frequently seen as the "chemist from Freiberg," who now turns up where gold and silver are worked in the far West. Some of these "experts" became in time very skillful in their business. They had not had the time to become very familiar with the chemistry of hydrocarbons generally, and "light product," to designate one portion of the distillate, and "heavy product," to distinguish another, almost comprised their nomenclature; but they were practical and intelligent men, and none the less efficient for being unacquainted with the very remarkable substances and compounds which, since then, chemists have been so good as to discover in the "crude distillate" from coal. At first the farmers in Ohio, at least, were rather opposed to any distillation which would not produce whisky, and made objections to disposing of lands offering good coal prospects, for which the coal oil distillers soon developed a very keen scent. The country ministers, in many cases, could not be persuaded that anything could be distilled from coal, and insisted that coal distillation was a cloak for another kind, much more to the taste of their flocks. The writer remembers being denounced in meeting as "Satan's messenger," because he had brought two cast iron stills and a lot of condensers into Muskingum County from Cincinnati, and was hunting up work on a cannel coal seam which promised well.

Following kerosene, came Breckenridge, paraffine, Lucasco oil, Downer's kerosene, and others. The kerosene patents passed into Downer's hands after a few years, and he used the Albert coal, or asphaltum rather, of New Brunswick largely at his works in Boston. The Breckenridge Company worked under Young's patent, and produced an excellent burning oil. The processes described in both patents were much improved as time went on. Mr. A. C. Ferris, of Tarentum, Pa., introduced the first burning oil made from petroleum. This was the "carbon oil."

In all cases where coal was used, the result in yield and quality of oils was largely influenced by the heat employed in procuring the "first distillate." To effect the distillation of all of the products from coal, and at the same time to produce the smallest quantity of gas or uncondensable matters, was the object. The distillation was usually conducted in gas retorts, with a condensing apparatus attached. Large clay retorts were also used. An invention of Luther and W. Atwood was tried, with good results. It was called a "meerschaum," and was an upright furnace resembling the bowl of a pipe into which the coal was dumped, the fire started from the top, a suction blower carrying it down through the mass, and the condensable products running off at the bottom. It was capable of working large quantities of coal at a time. When coal is cheap, and a not very fine quality of oil is expected, it might prove useful and profitable.

The crude distillate, however obtained, was distilled and separation made of the different parts, as ascertained by the hydrometer. These separated parts were treated with their proper proportion of sulphuric acid and caustic soda alternately, then usually redistilled and treated, the products of the whole manufacture being naphtha, burning oil, and lubricating oil. The gas produced was usually collected and used as fuel or for lighting the works. Coke making coals afforded fuel also. Pitch or tar from stills was also made. The carbolic acid and ammonia were not taken account of, and were permitted to run to waste, nor was the sludge acid recovered in any way.

Petroleum refining is rather an easy affair compared with coal oil refining, and the latter certainly costs more; yet though petroleum has brought great wealth to the country, and to look closely into it may seem rather like looking a gift horse in the mouth, it is a question whether it would not, on the whole, have been a good thing for the United States if petroleum wells had never been discovered and opened. Petroleum has destroyed, in the most frightful way, many thousands of lives. It is never, in a crude state, or when improperly refined, as safe as gunpowder in destructive properties. It is not an overestimate to place the loss at one-fifth of all the value it has produced, to say nothing of the lives it has taken. It is true that the price of refined petroleum to the consumer, say 15 cents per gallon, is not high, but the best kerosene or paraffine oil from coal will burn, with equal light, measure for measure, twice as long as refined petroleum, and with perfect safety—an element that may fairly be considered in calculating values.

The able and exhaustive report on "Petroleum as an Illuminator," by Professor Chandler, in 1871, shows how unsafe most of the refined petroleum then was unless it had been manufactured by firms who made a special bid for popular approval by care in that particular. Most of the refined petroleum at the present time is, perhaps, fairly safe, but it never has equaled coal oil in that respect. The best kerosene and paraffine oils are as safe as need be, the Breckenridge, the Downer, of Boston, and R. S. Merrill's is an illuminating oil which was as safe as sperm oil and not more readily ignited. When coal oil distillation was abandoned, lamps to burn it were becoming quite perfect. The iron interest would have been greatly benefited by the continuance of the coal oil distillation, its consumption of that metal being large. The chemical manufacturing industry, which it is hoped will become more and more a domestic one, would also have been benefited by the continuance of coal oil distillation.

In place of being carried on with immensely dangerous storage tanks in crowded localities, as much of the refining of petroleum now is, coal oil works would be scattered over a large area, one equal to that of the cannel coal fields, along the tributaries of the Ohio, the Tennessee, and Missouri, each works becoming the center of industry, and each contributing to the wealth of the country in many ways that petroleum never can. The output of such works would be:

Illuminating and lubricating oils, paraffine for candles and other uses, naphtha, and benzole for aniline, ammonia, and carbolic acid.

It would require undoubtedly a very large quantity of coal to supply the oil demand should the petroleum wells cease flowing altogether—not less than 12,000,000 tons per annum of average yielding cannel; but that is a most unlikely thing to occur. It is to fill the demand gradually that coal is to come into play. Sixteen companies are now distilling bituminous shales in Scotland, yielding 25 gallons of paraffine oil per ton, and are reported as paying a good profit.

The time has arrived when coal oil could be distilled to profit in the cannel coal regions of Kentucky, Virginia, Ohio, and Pennsylvania, at least; not because petroleum has advanced in price, but because all of the products of the distillation of coal are of greater value than they formerly were, their utilization better understood, their heavier oils and paraffine more in demand, and the perfect safety of their burning oils more appreciated by the public. There is little doubt that a burning oil made from coal, and advertised as such, would command a higher price than refined petroleum.

The following estimate of the value and cost of the product of a ton of Virginia cannel coal will afford a fair basis for calculating the profits of coal distillation:

PRODUCTS.	
Kerosene (25 gal. @ 10 c.)	$2.50
Lubricating oil (10 gal. @ 16 c.)	1.60
Paraffine (12 lb. @ 9 c.)	1.08
Naphtha (10 gal. @ 10 c.)	1.00
Ammonia (10 lb. @ 3 c.)	.30
Carbolic acid (10 lb. @ 10 c.)	1.00
	$7.48

In many cases the coke and illuminating gas obtained are items to the credit of the coal, to the extent of 1,200 pounds of coke, and 4,500 cubic feet of illuminating gas per ton. The cost would be for coal, reagents, labor, wear and tear of building, etc., $4 per ton, the net profit being $3.48 per ton. Works capable of distilling 100 tons per day of cannel coal would cost at the present time $100,000, and the profit being $348 per day, it is not at all a poor one. In a very complete condition and capable of producing the acid and caustic soda it would consume, $40,000 in addition would be needed: but the profit would be increased almost in proportion. In the Kanawha Valley and at other places, sulphuric acid could be had from domestic sources, and caustic soda from the salt there made or from that of Louisiana. There is no need whatever of our country depending for its chief chemical reagents upon any other, and yet at the present time Sicily sends us sulphur and England soda ash.

It is doubtful whether there is any coal region known that will compare with that indicated. It is vast in extent, indeed. Most of its coal seams can be mined in the simplest manner, 90 cents per ton being its average cost at works and factories near by. A large proportion can be mined in hills which the seams, 4 and 6 feet in thickness, pierce. Adits can be driven in the seams themselves, and drainage and ventilation had to any extent without pumps or furnaces. The investment of $140,000 to produce 4,500 gallons of oil per day may seem large to the petroleum well owner; but wells cost the owner very frequently very high prices in land values and other costs, and they have no element of stability to compare with that of the coal seam. The great flowing well soon becomes a pumping well. At the present moment, petroleum is nearly 16 per cent. greater in specific gravity than it formerly was, and is entailing some change in its treatment in consequence, as refiners are realizing to their cost. This increase in specific gravity indicates that there is a gradual falling off in the area of light oil production, and that the oil regions have blown off their froth and must settle down to less profitable production. If the cost of unproductive wells were added to the cost of all, it may be that the coal seam would show us the best investment.

As a rule, a dull fracture, great comparative lightness, and easy inflammability in a candle flame are favorable signs of an oil coal. Sometimes shales and schists of inferior appearance are rich in oil, the value of any of these bituminous substances depending largely upon their situation with regard to rivers, railroads, etc. The value of each item of the distillation must be considered before any proper estimate of the value of any coal can be made. A correct idea of the value of any coal cannot be had by merely ascertaining the amount of volatile matter it may yield. Boghead coal yields more volatile matter than Breckenridge, and yet the latter yields 10 per cent. more of marketable oil. An experimental test of any coal, carrying it out to its last results, is the safest way of getting at its value, varying the heat under which it is distilled to suit its character and to obtain its best results.

The literature of coal oil is limited. Dr. Antisell, in 1859, published "The Manufacture of Photogenic or Hydrocarbon Oils." This was a carefully written work. Dr. Gesner, in 1861, published "A Practical Treatise on Coal, Petroleum, and other Distilled Oils;" and in 1865 a second edition was published of the same work, by G. W. Gesner. These were practical works, with drawings and the apparatus used at that date in distilling coal and petroleum oils. Prof Henri Erni brought out a volume in the same year, giving the chemistry of the hydrocarbons principally. It was entitled "Coal Oil and Petroleum: their Origin, History, Geology, and Chemistry; with a View of their Importance in their Bearing upon National Industry." Prof. Henry Wurtz has made very careful examination of coal products, as is shown by his pamphlets. Prof. Chandler's report, in 1871, before mentioned, completes the list in this country. These works are out of print, and can only be found at the libraries. There are several German and English writers who have noticed the subject generally.

There is a wide field, in all senses, for the manufacturing chemist in the distillation and treatment of coal oils. The efforts of many minds had brought coal oils to a condition almost perfect when the manufacture was arrested. At the present time, it would need only care to arrange all the details of the process of such a manufacture; the processes themselves have been already invented. Whether coal will soon again be called upon or not to supply the demand which petroleum has certainly fostered, there was a great industry begun when, at the works on Newtown Creek, was produced the illuminating oil whose name has become a household word—Kerosene.—*Eng. and Min. Jour.*

IODINE.

By CHARLES EHRMANN.

Iodine. Symbol, I. Eq., 127.

IODINE, discovered by Courtois in 1812, is, like chlorine, disseminated all over our planet. It is never found in its free state or in large quantities. In the mineral kingdom it occurs but rarely, and when found is bound to either mercury or silver. It is more frequent in mineral waters and saline springs. It is prepared commercially from kelp, the ashes of certain deep sea fungi and other marine plants, where it usually occurs as iodide of sodium.

At an ordinary temperature iodine is solid, of a gray color and metallic luster, resembling graphite, with which it is sometimes adulterated. It has a peculiar odor, is volatile, becomes liquid at 102 deg. F., and boils at 180 deg. F., when it is resolved into deep violet vapors. The color of these vapors suggested its name, for *ἰοδες* means in the Greek language violet. When sublimed, it forms rhomboidal crystals. It is easily soluble in ether and in alcohol, but little in water (1 to 7,000). The presence of free iodine is detected by boiled starch, which is rendered intensely blue by it. When a small quantity of an iodine salt—as, for instance, iodide of potassium—is added to starch, with the addition of a few drops of diluted chlorine water, iodine is liberated, and produces the blue color. If, however, the least excess of chlorine be present, the color does not appear, as chloride of iodine is immediately formed.

In many countries seaweed is burned for the sake of the ash, the product being a dark colored, fused mass called kelp.

This substance, besides carbonate of soda and iodine of sodium, contains more or less common salt, chloride of potassium, sulphate of soda, etc. The deep sea fungi contain most iodine, and when they are burned at a low temperature for fuel, as is the case on the island of Guernsey, their ashes furnish more iodide than ordinary kelp. On an average, ordinary kelp contains $\frac{1}{212}$ part of iodide. It is lixiviated with water, in which about half of it dissolves. The solution is concentrated to a pellicle, and allowed to cool, whereby nearly all the salts, except iodine of sodium, are separated, they being less soluble than that salt. The mother liquor, which is dense and of a dark color, is acidulated by the addition of sulphuric acid, which causes an ebullition of carbonic acid, sulphureted hydrogen, and sulphurous acid, and the deposition of sulphur. The liquor is then introduced into a leaden still, and distilled with dioxide of manganese into a series of glass receivers inserted one in another, and in which the iodine is condensed. In this process the iodide of sodium is decomposed, and the iodine evolved, sulphate and protoxide of manganese and sulphate of soda remaining. The crude iodine is rectified by sublimation.

Iodine has no equal in its importance to the photographer. By its means Father Daguerre was enabled to make the first sun pictures—daguerreotypes, properly so called from their inventor. At one time, and not so very far remote, it seems to me the daguerreotype took up all our attention and energy, and pictures were made which stood high in the estimation of the public.

About the time when the talbotype was first introduced in America, daguerrean pictures had reached with us a point of superiority which made the American daguerreotypist pre-eminent over his *confreres* of other countries, and justly so. Pictures made at that almost forgotten time can even now be well compared with any glass or paper photograph ever made. Many of us remember yet the works of Whipple, Brady, the two Roots, McClees, Pollock, Whitehurst, Hesler, Fitzgibbon, Whitney, the brothers Peal, and others. It may not be in place to give expression to sentiments, but "old love never rusts."

The eminent results obtained by the daguerreotype process induce me to say something of the part iodine took in that process. A plate of copper having a highly polished metallic silver surface, was submitted to the action of the vapor of iodine till rendered of a violet hue. In this state the plate was not ready, however, for the exposure to light, it having to undergo repeated fuming till its color changed from violet to yellow, then rose color, and finally gray. The original process of Daguerre was conducted with the vapor of iodine only. The discovery of Goddard, which increased the sensitiveness by means of bromine, came much later, and will not be considered here. The deposit of iodide of silver upon the plate was so attenuated that it could hardly be detected by a delicate balance. After exposure to light the image remained latent, as in other processes, and had to be developed, in this case, with the vapor of metallic mercury. Few questions have given rise to such protracted discussion as that of the nature of the daguerreotype image. The quantity of the material to be operated upon was, however, so small, that it was quite impossible to ascertain its composition by direct analysis. There appears but little doubt that the image formed consists of metallic silver and mercury in the state of a mercurial amalgam.

In modern photography free iodine is employed, either in the form of tincture or an alcholic solution, and sometimes as an aqueous solution, when it is rendered soluble by an excess of an iodide haloid. Its use as an addition to collodion is well known. The operator removes silver stains from his hands with tincture of iodine, iodide of silver being formed, which is afterward taken off by a solvent like cyanide of potassium or hyposulphite of soda.

Iodine will combine energetically with non-metallic bodies. There are known to exist an iodic acid (IO_5) and a periodic acid (IO_7), the first of which may form occasionally when certain photo-chemical processes are in operation, but does not need our special attention.

With hydrogen, iodine forms an acid similar to hydrochloric acid, which is easily decomposed by the oxygen of the atmosphere.

Iodine of nitrogen, a most explosive substance, is formed by mixing iodine with ammonia. The attention of photographers has of late been directed to this body, owing to its great sensitiveness to light. Under its influence, nitrogen is liberated, and iodide of ammonium and iodate of ammonia are formed. A strong light accelerates the decomposition; the most energetic action takes place under the yellow rays, the least under the violet. Guyard intends to use these reactions for photometric purposes, measuring the amount of liberated nitrogen.

Metallic Combinations of Iodine.—Of all the iodides, let us consider the one first brought to our knowledge—iodide of potassium (KI, eq. 166·1). When it became necessary to form iodide of silver by double affinity, potassium iodide was introduced for that purpose by Talbot, Le Gray, the Langenheims, Whipple, Archer, and others. When daguerreotypy began to be discarded, sensitive paper was made, and sensitive films of albumen, serum, collodion, etc., were formed, using for that purpose iodide of potassium and nitrate of silver.

Iodide of potassium is an anhydrous salt. It crystallizes in cubes, is volatile at a very high temperature, and very easily soluble in water. Alcohol dissolves 1 part in from 40 to 60. (According to Hardwich, 1 part in 180 absolute alcohol.) The commonest impurities contained in this haloid are the chlorides of potassium and sodium, bromide of potassium, and carbonate and iodate of potassa.

The presence of a chloride may be determined by nitrate of silver. This test throws down from the pure salt nothing but iodide of silver, which is scarcely soluble in water, while chloride of silver is readily dissolved. If a solution of impure iodide be precipitated by an excess of nitrate of silver and agitated with ammonia, the latter will dissolve any chloride which may be thrown down and will yield it again as a white precipitate on being saturated with nitric acid. If, on the other hand, the iodide be pure, the ammonia will take up only a minute quantity of iodide of silver, and the addition of nitric acid will scarcely disturb the transparency of the solution.

The low price of bromide of potassium, compared with that of the iodide, has caused it to be used as an adulterant. When it is suspected that bromide is sold for iodide, the fraud may be detected by the addition of sulphuric acid, which produces copious reddish fumes in place of the purple ones arising from the pure salt.

Bromine is detected by adding, in excess a solution of sulphate of copper and aqueous sulphurous acid to an aqueous solution of the iodide. This gives a precipitate of protoiodide of copper. On treating the filtered liquid with ether and chlorine water, if bromine be present the ether which rises to the surface will be tinged with a reddish-yellow color.

Carbonate of potassa may be discovered by lime water, which causes a milkiness (carbonate of lime), and by tincture of iodine, the color of which is destroyed. (Wood and Bache.)

The preparation of iodide of potassium is not very difficult, and even an amateur chemist or photographer can easily make it. To 6 ounces of caustic potash dissolved in boiling water add 16 ounces of finely powered iodine, or till the solution begins to show by its color that a slight excess of iodine is present. Evaporate the solution to dryness, adding and stirring in finely powdered charcoal. The powder obtained is heated in a crucible to a dull red heat, and, after cooling, the saline matter is dissolved in distilled water, evaporated, and crystallized. Formerly this haloid was produced by first making iodide of iron, of which I shall speak later, decomposing it by carbonate of potassa, which gave rise to iodide of potassium and a carbonate of protoxide of iron.

The chief use of iodide potassium in the photographer's laboratory is to form from it and nitrate of silver the sensitive iodide of silver as a fine precipitate, nitrate of potassa remaining in solution.

Iodide of potassium from its meager solubility in alcohol has given place to other iodides more readily dissolvable, though some collodions are still sensitized with it to produce certain effects. For sensitizing albumen or albumen and honey films it is exclusively used, while in gelatine films it is occasionally employed. Although other iodides are much preferred now, iodide of potassium must be looked upon with a certain degree of veneration. With it paper negatives have been made, solar prints by development, talbotypes, crystallotypes, and the first collodion negatives, dating as far back as the time when James Cutting peddled Archer's collodion process throughout the United States.—*Photographic Times.*

THE MERCURIC DEVELOPER.

By HENRY J. NEWTON.

AT the November meeting of the Photographic Section of the American Institute, I gave my formula for an accelerator, which, curiously, has been mixed with the formula I had on a previous occasion given for an intensifier of the mercury salt, so that, if used as misquoted, it would be useless for such purpose, and spoil the developer. In order that my formula may have a fair test, and also to prevent people from wasting their time uselessly with a foolish version of it, I thought it best to have it correctly reprinted in the *Times.*

A.

Bichloride of mercury	30 grains.
Water	4 ounces.

B.

Iodide of potassium	90 grains.
Water	1 ounce.

When the two salts are thoroughly dissolved, pour the iodide into the mercury solution gradually, until all is added. The result should be a clear solution, as the excess of iodide will dissolve the red precipitate seen on first mixing the two solutions. This forms the iodide of mercury, which I have used as an accelerator in conjunction with the carbonate of soda developer, made as follows:

Carbonate of soda	25 grains.
Sulphite of soda	4 "
Pyrogallic acid	2 "
Water	1 ounce.

I usually make my stock soda solution 100 grains strong, and reduce as required.

A solution of bromide of ammonium, or citrate of soda, should be kept in the dark room for use in case of overexposure, or the developer can be reduced with water to check development.

In order to succeed with this accelerator, the sulphite of soda should not be omitted. I may not have stated that fact at the meeting, as I did not think it necessary at the time, and because I had so often given my formula for the soda developer that I took it for granted every one understood what proportion of sulphite should be added to the soda.

I have had reports from quite a number, and some have succeeded satisfactorily, and others have not. Those who failed, so far as I can ascertain, have not used the sulphite in the developing solution.

HEATH LODGE, HAMPSTEAD.—ROWLAND PLUMBE. F.R.I.B.A., Architect.

The principal effect of the sulphite seems to be to prevent rapid oxidation or precipitation. Without it a precipitate is formed, and, of course, decomposition of the mercuro-iodide compound.

When a plate has been very much under-exposed, bring out as much as you can with the soda developer in four or five minutes, then drop into your graduate three drops of the mercuro-iodide solution for every ounce of developer. Pour the developer into it, so as to thoroughly mix it, and then flow over the exposed plate.

A 50-grain solution of iodide of sodium, used in the same way, acts as a good accelerator.

A 30-grain solution of iodine in alcohol, to which 40 grains of pyrogallic acid are added, makes a good stock solution for accelerating development, used the same as the other. A solution of iodine in water and iodide of ammonium will prevent any development whatever.

In using carbonate of soda, I always use the dry or granulated. The ordinary crystals are more than 60 per cent. water, which should be got rid of, so that in weighing you should weigh soda and not water. By leaving the crystals exposed to the air, the water will evaporate and leave the soda in fine powder. If you wish to expedite the evaporation, pulverize the soda and subject it to heat.—*Photo. Times.*

FINGARRY, STIRLINGSHIRE.

THIS residence, which we illustrate, has been recently erected for Mr. John Hunt on a beautiful site at the foot of the Campsie Hills. The situation commands a wide view of the surrounding country to the south and west, and the principal rooms have been arranged to take the fullest advantage of the prospect. The house is built of a warm-tinted sandstone, and roofed with sea-green slates with red ridges; and the internal fittings have had very careful attention, mantelpieces, cabinets, bookcases, etc., having been specially designed by the architect, with very successful results.

"FINGARRY," MELTON OF CAMPSIE, N. B.—JOHN B. WILSON, A.R.I.B.A., Architect.

Stained glass has been freely used throughout the house, the staircase window being composed of subjects from the "Idyls of the King," and the upper lights of drawing-room windows containing a series of cherub figures illustrating outdoor sports, which we hope to publish on an early date. The windows of the other public rooms are similarly enriched.

The work has been carried out from the designs and under the superintendence of Mr. J. B. Wilson.—*The Architect.*

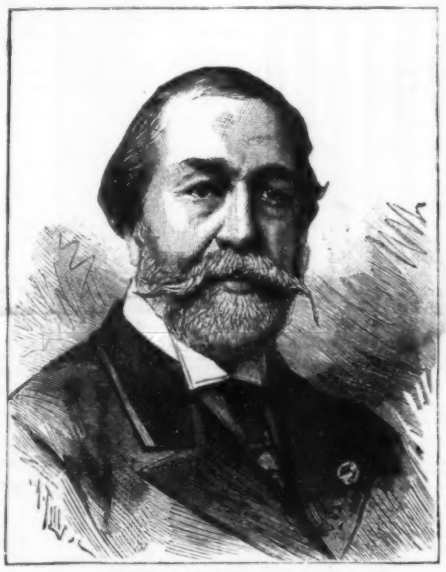
THEODORE DU MONCEL.

THE eminent electrician whom science has just been robbed of by death was the son of Count du Moncel, a general of talent and a peer of France under Louis Philippe. Young Theodore received a brilliant education, and, upon leaving college, developed a decided taste for the arts and for drawing. He published a treatise upon mathematical perspective, and gave himself up to the study of archæology. His ardent mind, thirsty for knowledge, soon became imbued with a desire for adventure, and he undertook long voyages in Italy, Greece, and the Levant, acquiring on his way that maturity of intelligence that traveling never fails to give. Here turned home with an ample stock of documents, impressions of a tourist and artist's sketches, which he collected together into a large folio work that he published in 1847, under the title of "From Venice to Constantinople through Greece."

Other archæological works succeeded this first attempt, the young author himself executing with his own hands the lithographic plates that were to illustrate them. Would it be believed that these publications did not greatly please his family?

His relatives, thoroughly imbued with vain prejudices, regretted to see the young Count devoting himself to such labors, and requested him to give up archæology and to occupy himself with the surveillance of his domains, like a gentleman of olden times. But, it being the vocation of young Du Moncel to work and study, he was obstinate to the wishes of his relatives, and, after a lamentable strife, broke with them. Thereafter it was forbidden him to rely upon the least aid in the career that he wished to follow.

Obliged to give up his art publications and archæological studies, which necessitated considerable outlay, he devoted



THEODORE DU MONCEL.

(Born March 6, 1821. Died February 16, 1884.)

himself to science, and especially to the study of electricity, for which he had a decided taste. He taught himself without the aid of a master, and made his debut as a scientific writer in the *Journal de l'Arrondissement de Vologues*, in which he published a series of articles upon "New Discoveries in Electricity." These articles were the origin of a numerous series of publications upon electric science, a subject in which the author soon became an authority. Under the title of "Expose of the Applications of Electricity," Du Moncel put forth a series of highly esteemed illustrated works, the last edition of which forms five octavo volumes.

Mr. du Moncel's works are principally devoted to induction currents, piles, and electro magnets. It is to him that we owe the discovery of the electric effluve, which has rendered so many services to chemistry, and which became a valuable combining agent in the hands of Paul Thenard, Mr. Berthelot, and several other savants.

Between 1850 and 1856 Du Moncel constructed more than twenty-five new apparatus, which obtained for him a first class medal at the exhibition of 1855. The electric anemograph, electric water-level measurers, electric registerer of musical improvisations, automatic temperature-regulator, apparatus for lighting dark cavities in the human body, a system of telegraphy, a registering galvanometer and electric locks—such are the principal ones of the very ingenious instruments that the inventor constructed. In addition, Du Moncel discovered the effects of hidden and condensed magnetism, and made known, too, the best methods of constructing electro magnets, according to the purposes to which they were to be applied.

In 1860 Mr. Du Moncel was appointed electric engineer of the Administration of Telegraphs; in 1866 he was made an officer of the Legion of Honor; and in 1874 he was elected a free member of the French Academy of Sciences.

With a mind of wonderful fertility, the learned electrician kept publishing, sometimes in too exuberant abundance, a series of articles and notes upon those numerous discoveries that have in recent times been made in electric science. Editor in chief of *La Lumiere Electrique*, he filled the pages of that journal with his writings, and at the same time published several volumes upon the progress of electricity in the *Bibliotheque des Merveilles*. The titles of these books are "The Telephone," "The Electric Light," "The Microphone and the Phonograph," and "Electricity as a Motive Power."

To make our enumeration complete it would also be necessary to cite among Du Moncel's former works his "Treatise on Electric Telegraphy," his "Notice upon the Ruhmkorff Coil," his "Studies upon Magnetism as regards its Applications," and innumerable notes inserted in the *Comptes Rendus* and in the *Bulletins* of learned societies.

Those great modern discoveries that have transformed electricity at first somewhat nonplussed our savant, who had been reared in the old school. When the news of the discovery of the telephone came to us from America, Du Moncel did not care to believe in it, and the articles from American journals upon the subject which *La Nature* was the first to publish in France he treated very severely as *canards;* and he still refused to believe in the telephone when the first apparatus was presented before the Physical Society of Paris.

It was necessary, however, to succumb before the evidence, and Mr. Du Moncel, like a man of sense, did not fear to speak of his mistake. I remember that one day, on meeting him at the Exhibition of Electricity in 1881, he told me himself how impossible a thing a realization of the telephone had appeared to him, and contrary, said he, to all theoretic notions. "I shall never more deny anything whatever," he added, "for nothing is impossible to science."

Mr. Du Moncel married the daughter of Count de Montalivet, the minister and devoted friend of King Louis Philippe.

Were his ancestors still living, it is probable that they would no longer regret that one of their kin had devoted himself to the study of the sciences; and they would recognize the fact that Count du Moncel did not degrade himself in rising through work and in signalizing himself by useful discoveries.—*Gaston Tissandier, in La Nature.*

ELECTRIC SHADOWS.

ON reading Prof. Thompson's communication to *Nature*, giving the result of Prof. Righi's researches on the production of electric shadows in air at the ordinary pressure, I at once endeavored to repeat the experiments with such simple means as were at hand. Two sticks of sealing-wax stuck to a small iron stand sufficed to support a long, big-headed pin and the screen or object for casting the shadows. Instead of a plate of ebonite I used a cake of resin of six inches diameter, which serves ordinarily for the production of Lichtenberg's figures; and from subsequent experiments it would seem that the resin serves the purpose *almost* as well as ebonite as far as clearness of definition is concerned. A metal plate, which may or may not be insulated, formed a base for the resin. I mention these details, since the ebonite rods and plate are not so well within every one's reach, on the score of greater expense and the necessity of having them specially constructed for the experiments. A plate

machine of some size (18-inch plate) seems necessary, as I find that, unless the Leyden jar is charged to rather high potential, no shadow is formed, and, further, that the sharp definition of the shadows increases with the charge of the jar. The screen used was a design, cut out in cardboard and tinfoil pasted over it, very similar in shape to that given in Fig. 2 in Prof. Thompson's paper, and the shadows obtained were substantially similar to that in Fig. 3. But here a small point not before recorded came out: If the pin from whose point the discharge is made to take place be slanted in any direction, which is easily done with the sealing-wax holder by simply heating, the shadow of the object then lengthens out curiously, just as do the shadows formed by an object intercepting light rays as the obliquity of incidence is increased.

The new feature, however, which appeared from my experiments, and which is not recorded by Prof. Thompson, although very likely the experiment may have been done before, is as follows: Instead of starting with the resin plate in a neutral condition, I gave it a rather strong negative charge by rubbing it vigorously with a fox's brush and discharging the Leyden jar as before on to the pin, using precisely the same object to cast the shadow as before. Its character now, however, was completely altered, appearing as I have endeavored to represent it in the figure. A simple cross, having little resemblance as to outline with the object, was the result. The red-lead of course was picked out by the negatively charged resin under the object and piled up to form the cross, which was much more strongly red, as one would expect, than the former shadow. There was also a rather wide neutral regi on around the cross, considerably more than in the former experiments. It seems to me that this effect is something more than the attenuation of the shadow spoken of by Prof. Thompson, where the screen is electrified independently. Since the subject is one of considerable interest, perhaps it may be useful to show that any one having access to a fairly good electrical machine can repeat and possibly extend Prof. Righi's investigations. —*W. F. Smith, in Nature.*

ELECTRICAL READING OF A THERMOMETER AND HYGROMETER AT A DISTANCE.*

By ARTHUR WM. WATERS, F.G.S., F.L.S.

IN cold districts, such as the mountainous regions of Switzerland, it is very difficult to find persons willing to go any distance through the snow, early and late, to take meteorological observations, and in consequence meteorologists among the Alps place the instruments in metal boxes just outside their windows. As an invalid, and unable to expose myself to the weather at any hour, I set to work to see if a thermometer could be arranged to be read electrically at a distance.

Having had my thermometer working satisfactorily for about three months, and having just completed a hygrometer, I feel justified in describing them as practically useful.

* From the *Quarterly Journal of the Meteorological Society.*

Hermann's spiral metal thermometer, which consists of a spiral of two metals welded together, is employed. The center of the spiral is fixed, and the other end moves a hand. The instrument serves as a maximum and minimum; having two light indices, which are moved to the right or left as the temperature rises or falls, and then are left, one at the highest and the other at the lowest point.

I have also adapted my principle to the hair hygrometer, which moves a hand in the same way as the thermometer.

In order to determine the position of these hands it was necessary to make a satisfactory electrical connection, without influencing their indications, as a slight force would either retard their action or move them out of their position.

Eventually the plan was adopted of making the scale with raised wires in connection with a galvanometer in my room. The scales were constructed of pieces of ebonite mounted on hard wood. In the scale, *b*, *b* (Fig. 1), grooves were cut in

FIG. 1.

which the wires were laid. The silk covering was removed from a small portion of a length of German silver wire 0·3 millimeter in diameter, and this uncovered part was placed in the grooves, being tightened by drawing its end through holes bored in the hard wood which supported the ebonite. The spaces between the wires were then filled up with shellac, so that a firm and solid scale was made, with alternate metallic and insulating spaces.

The whole scale is supported on two brass pillars passing through it at each end, and this can be raised or lowered, and held in position by the screws shown.

The scale was placed about 1 millimeter below the index, with an electro magnet, *d*, *d*, on each side, and above these there is a long armature, *e*, *e*, which is attached by watch springs, *f*, *f*, to two pillars, being less than a millimeter above the index, until a current is sent through the electro-magnet, *d*. When the armature is attracted it pulls down the index on to one of the wires, where it is held tightly, thus making a good electrical connection.

The instrument is being worked with a cable containing 25 fine wires, and the thermometer scale is divided to thirds of a degree Centigrade.* The cable is 85 meters long, and consists of 25 wires 0·2 millimeter in diameter and 5 wires 0·4 millimeter in diameter, in both cases double cotton covered. One leading wire is electrically connected with the index of the thermometer, and another with that of the hygrometer. This is not fastened to the index, as the free

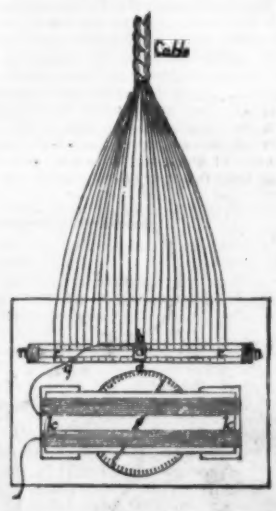


FIG. 2.

action might thus be interfered with, but to its bearing. In this way the electrical current passes along the index, and as soon as the circuit is closed by the index being brought into

* Since the above paper was written, the author has completed another instrument, in which the divisions were to 0·1° C., and as the weak point of the system is the slow action of the thermometer, he had a more sensitive thermometer made by Hermann and Pfister, of Berne. This consisted of two spirals a short distance apart and connected up to work the same index. The spirals were made of steel and brass, instead of iron and brass, and could thus be smaller, and more sensitive. The divisions being to 0·1° C., the scale was longer, and so it was found advisable to adopt an armature with a double curve instead of the straight one. As a series in this case only represented 2·1° C., he attached small blocks of insulated German silver to the under side of the armature, which, when drawn down, made contact with the index, and by means of thin wire leading from each block was able to tell when contact was made in the same way as with the scale. This is probably better than the plan first used, where each wire of a series had a certain measured resistance interserted.

contact with one of the wires of the scale, it is shown upon a small galvanometer in the room.

The apparatus for reading the temperature indicated is as follows (Fig. 2):

Twenty-one stout wires are laid upon a square piece of wood, and attached severally to the ends of the wires of the cable. A brass spring, running loosely on a brass bar, *c*, is placed above the stout wires, and then one of the wires, *g*, of the galvanometer is fastened to the upper end of this spring by means of a binding screw, *b*.

It will be seen that if the index of the thermometer is touching one of the wires of the scales it is only necessary to bring the spring over the corresponding wire to close the circuit, which will be indicated upon the galvanometer. This is done by sliding the spring along the bar, *c*; and when the right wire is reached, the galvanometer needle is deflected. Any simple compass or astatic galvanometer is sufficient for taking the readings.

The galvanometer, *k*, *k*, is attached to the same small board as the "reader," *n*, *n*, and in this way, by having a sufficiency of spare cable, the board with reader and galvanometer can be carried about, and by using a battery, as Leclanche's or Daniell's, can be even used in bed, the board being placed on a table by the bed ready for the early morning observation.

A small battery only is required, as two moderate sized Leclanche cells will work the magnets, and one small Leclanche cell is sufficient for the thermometer index and galvanometer in circuit.

BESSOLO'S ELECTRIC MOTOR AND SIEMENS' OPEN RING ELECTRO-MAGNETIC MOTOR.

IT is truly curious that certain apparatus, which were extremely remarkable for their time, have, at the period of their invention, been overlooked, and, from their very birth, been consigned to an oblivion whence some accident, sometimes years afterward, has rescued them in order to make of them interesting objects in the history of science. This was the case, as well known, with Pacinotti's machine, and

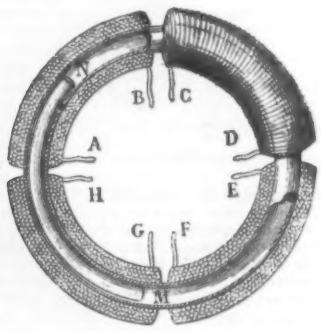


FIG. 1

it is also the case with Bessolo's motor, which contains, as we shall see, parts that have been thought to be of much more recent invention, and which applies certain very important principles that have since been taken up again.

The patent for this motor was taken out in 1855, and it appears that the invention dates back to 1853. At that period researches on the dynamo magneto-electric motor were in their prime. The repeated failures and useless efforts of so many men of talent (such as Froment and others) did not discourage experimenters, for it was plainly felt that it was possible to solve the problem, as has, in fact, since been done. The difficulties were beginning to be seen quite clearly, and ingenious efforts were being made to surmount them.

In the patent that he took out in France (Jan. 19, 1855, No. 22,114, in the name of Henry Gilbee; two certificates of addition), and in the explanatory pamphlet that he transmitted to Mr. Th. Du Moncel, Mr. Bessolo shows that he had been guided in his researches by a number of theoretical ideas, some of which are a little singular and have not been justified by time, while others, on the contrary, are entirely correct as well as remarkable. At that epoch it had been seen wherein lay the great defects of such motors as had up to then been tried. They all operated (save the exception to be noted) by a successive magnetization and demagnetization of certain pieces—a process essentially prejudicial, in that it causes a loss of work and does not favor high speeds, by reason of the time necessary for the magnetic actions. A large number operated by the alternating motion of an attracted piece which was afterward drawn back to its place—a mechanical arrangement which is always inferior to a continuous rotary motion, because of the inertia of the pieces, and which is yet the more defective in this case for the reason that electric attractions diminish rapidly when the distance increases.

Various motors had avoided one or the other of these difficulties. Quite a large number of them possessed a direct rotary motion, and, among these, we may cite the Elias motor, one of the simplest. Referring to the description of this latter* it will be seen that the inventor has not avoided the inconvenience connected with reversals of magnetism, although this is avoided, as it would seem, in the Page motor. In this last named apparatus there were, it is asserted, three successive solenoids, in which the same iron core was successively attracted and afterward carried back to its initial position, and the magnetic poles were reversed only in the solenoids, and preserved always the same position in the iron core. Mr. Bessolo proposed to unite these two advantages, but desired, however, like Page, to make use of solenoids so as to do without reactions of iron upon iron. To do this he proceeded as follows (we here allow the patent to speak for itself):

"The essential arrangement for obtaining the rotary motion is to bend the axes of the bobbin conductor and iron into a circle in such a way that the bobbin shall be continuous throughout its entire circumference, while the iron shall comprise only an arc of an extent to be determined, save always that the ring form be completed with a non-magnetic substance.

"If we suppose that this ring be movable in the interior of the bobbin, and that the conductor constituting the latter be traversed by the current over a section of its extent, of an angular amplitude equal, for example, to that of the iron, but so placed that its extremities are, one of them, at one of the ends of the iron and the other outside (always counting upon the common curvilinear axis), we know that the iron will, through its attraction upon the conductor, tend to enter into that portion of the bobbin that I shall designate as active, until its poles coincide with those of the active bobbin."

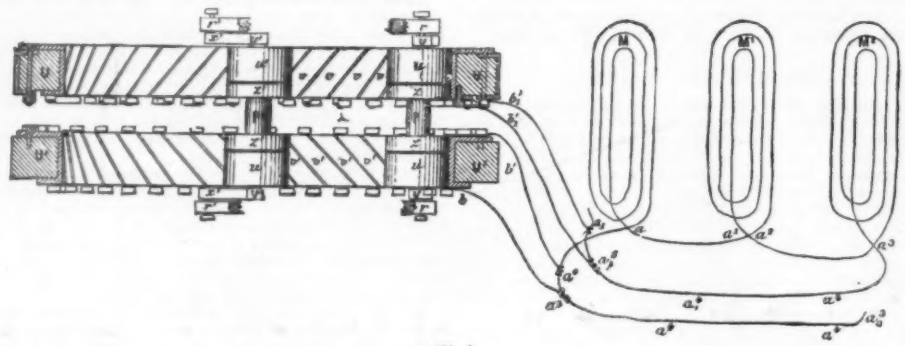


FIG. 4

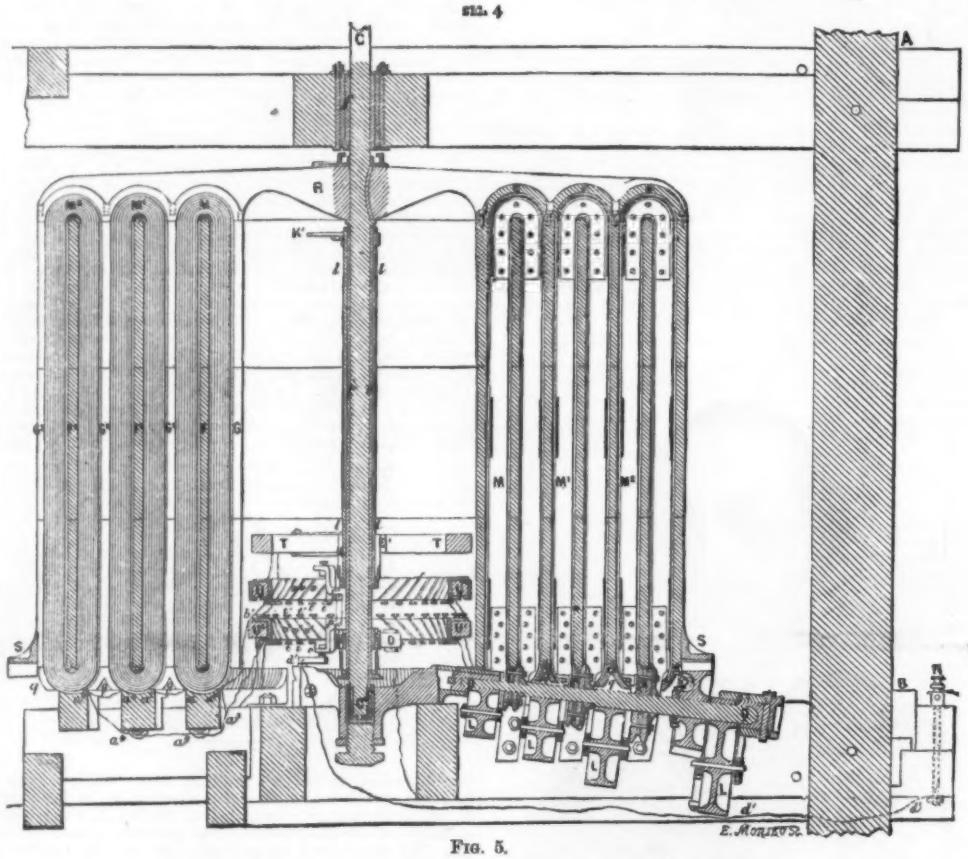


FIG. 5.

SIEMENS' OPEN-RING ELECTRIC MOTOR.

To cast more light upon the process, we may use the diagram shown in Fig. 1. As may be seen, it presents, as a whole, four curved solenoids that form a circle, and an iron core, MN, which has the same curve and is capable of revolving in their axis. If, while the iron core is in the present position, we send a current into the bobbin, AB, the attracted core will enter and move forward until its center coincides with the center of the bobbin. Its extremity, N, will then have entered the bobbin, CP. If, at this moment, we break the current at AB and send it into CP, the core, MN, will make another quarter revolution, and so on.

Upon directing the current properly, we shall be able, then, to give the core, MN, a continuous rotation. The effect will be the same if the core forms part of a magnetic circle whose complement consists of a non-magnetic metal.

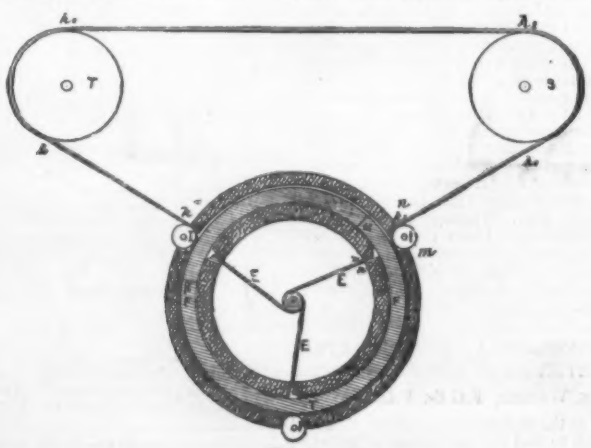


FIG. 2.

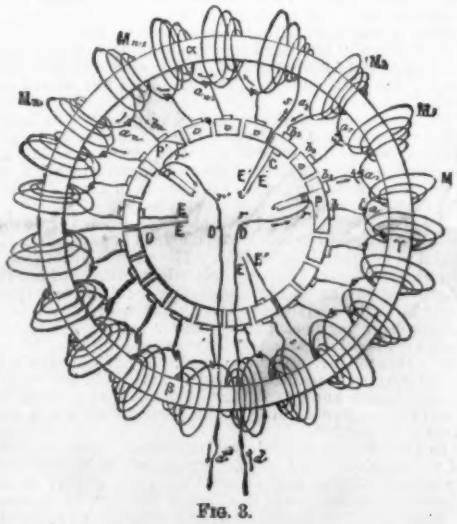


FIG. 3.

* SCIENTIFIC AMERICAN SUPPLEMENT, No. 315, p. 5016.

We shall further along see how Mr. Bessolo employs a move improved means of distributing the current; but, before this, there is a great and prime difficulty to be overcome: Our circular and hollow bobbin incloses the movable ring completely; how are we to seize its motion and make use of it? It will evidently be necessary to cut this continuous covering. Mr. Bessolo proposes various means. One of these is shown in Fig. 2 (from the patent), where the bobbin is divided into three parts, the spaces between which are occupied by rollers that carry and fix the ring. The latter receives a belt which communicates motion to external pulleys. In another arrangement the ring carries a toothed part, and the rollers are pinions; but, whatever be the arrangement, it is to be feared that it will not prove very

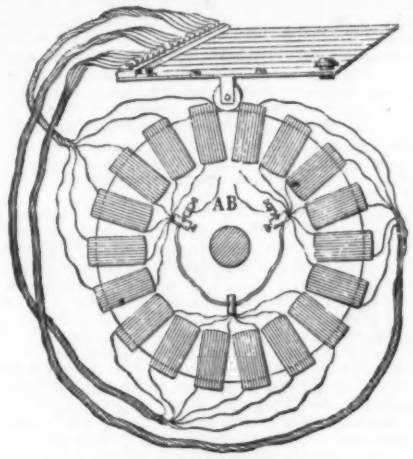


FIG. 7.

practical, and this is the delicate point in such motors and is probably why they have failed. Mr. Bessolo bestowed much attention upon the subject, as may be seen from the long elucidation that he has devoted to it in his patent. Two important points that he proposed to attain, and that he, in fact, did realize, were, one of them, constancy in the attractive force, and the other, invariability in the polarization of the iron.

If we suppose that the apparatus is constructed as shown in Fig. 1, the polarization of the iron will always be in the same direction, but its intensity, as well as the attractive force, will be continually variable according to the position of the cores relative to the successive bobbins. To have these two elements constant, the active bobbin must always

FIG. 8.

occupy the same position with respect to the core. The inventor succeeded in this as follows (Fig. 3, from the patent): The magnetizing ring, instead of being formed of a limited number of fractions, as shown in Fig. 1, consists of a large number of sections, M, M_1, M_2, that communicate with one another in such a way as to form a continuous circle; only, at the point of junction of two consecutive sections there is inserted a concluding wire that runs to a metallic key. These keys are arranged in a circle upon an insulating disk. The render will be at once struck by this, and there is no need of going on further with the description; it is a question here of the winding known as Gramme's, and which, before him, had been employed by Pacinotti. There is no doubt that the honor of this so ingenious arrangement, now so universally used, should be credited to Mr. Bessolo.

Is that saying, however, that the invention of the machine dates back to him? We do not think so; the inventor was able to make a motor only, and did not see that his machine could be reversible, this being something that Pacinotti very clearly perceived. Moreover, the machine, for generating electricity, could only be used as a magneto by magnetizing the movable core; and, besides, it is certain that its form is not practical and that it would fail at the moment of execution and work. Nevertheless, Bessolo certainly invented some of the essential parts of our modern machines, and that too at an epoch when no one, assuredly, believed that they were in existence.

Bessolo's ring possesses, moreover, one peculiarity which shows how carefully the motor was studied. Upon examining Fig. 3 closely, it will be remarked that the winding is interrupted at three points, marked *s*. The object of that is as follows: The current must be conveyed to the solenoid, and that is done by the aid of two rubbers, PP', which pass over the keys of the collector. The device formed by these rubbers is connected with the movable ring and revolves with it, so that the active part of the bobbin has always the same position with respect to the core of soft iron, whence it results that the attractive power is constant. But if the ring were continuous, the current entering through PP' would divide into two, and one part would go to the effective arc of the solenoid and the other to the complementary one. Such a division, which would be prejudicial, is prevented by cutting the circuit, *s*. In fact, two cases may occur if the arc embraced by P and P' be comprised between two cuts, *s*: the current will pass into the said arc and will not be able to pass on the other side, the circuit being cut; and, if between P and P' there is a division or cut, the current will pass nowhere. In this latter case the cut comprised between P and P' will have to be suppressed and a communication re-established, thus leading to the first case and permitting the passage of the current only on the effective side. This closing of the current is effected as follows: The cuts or divisions, *s* (Fig. 3), are connected with two wires, E, which are prolonged in the form of a spring and terminate near the center (Fig. 2). These abut against the axis, and the latter (between the parts that correspond to the rubbers, P and P') carries a metallic disk—the rest of its circumference being insulated. It follows that, between these rubbers, communications will be closed, while they will remain open externally, this being the object that was aimed at. Under such circumstances, the iron will revolve under the influence of a constant force, while it at the same time preserves a constant polarity. It will be remarked that the intensity of the attractive force can be regulated by modifying the distance apart of the rubbers, PP'.

The inventor, desiring to put to profit the currents induced by breakage, which are, as well known, direct, made use of a complex machine formed of three concentric solenoids containing, consequently, three movable cores. These solenoids are interdependent, opening and closing at the same time; the distributer is double, and composed of two parallel disks, or rather of two annular surfaces upon one and the same cylinder; and the rubbers are so arranged that, as soon as they leave the communicating disks, the latter become united with each other. We think that there are some exceptions to be made here, for it appears to us that it would prove difficult to effect such closing without breaking or without putting the pile in short circuit. It is not certain, moreover, that the extra current has an important mechanical value; it may be a loss, but it is difficult to believe that there is any utility in it.

Mr. Bessolo well saw the possible applications of his motion, and the section in his patent where he enumerates them is curious. We cite herewith the principal headings and a few words: (*a*) navigation; (*b*) railroads. "If piles are kept in the different stations, the current will be communicated to the locomotive engine by the rails or by a conductor insulated from the earth and supported in a manner analogous to telegraph wires, which latter might be attached to the same poles." (*c*) Ordinary roads; (*d*) ventilators and all high speed machines; (*e*) machines in general; (*g*) submarine navigation; (*f*) aerial navigation; (*h*) transmission of power to a distance. "In cases where one has need of the work of any motor at a certain distance from where the latter is stationed, the force that one has at his disposal may be employed to directly actuate a magneto-electric machine, and this, by means of telegraph wires, may communicate the current to an electro-magnetic motor. Thus, in the tunneling of mountains, advantage might be taken of waterfalls or winds for setting in motion one or several magneto-electric machines, which would communicate their current to an electro-magnetic motor connected with the machine tool that was performing the drilling, and placed in the same gallery with it."

Here is a very clear view of the applications of electric motions, and a curious prescience of results that are only beginning to be realized.

A considerable portion of the patent is devoted to special arrangements of the pile and to the utilization of its products, but there is nothing very new or interesting therein.

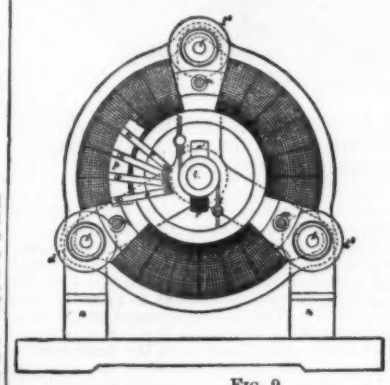


FIG. 9.

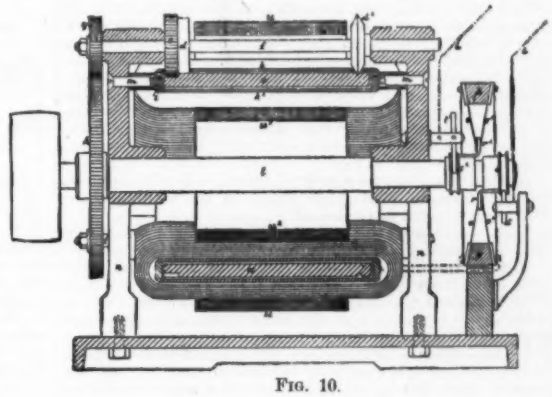


FIG. 10.

To conclude, it is not very probable, from a practical point of view, that the machine ever ran very well. To see why this must be so, it is only necessary to glance at Fig. 5, which shows the machine with three concentric solenoids. There is here a complication of mechanical means that is not very encouraging. Despite the ingenious magnetic combinations that it contains, this model seems entirely incompetent to do good service. It is, however, very interesting to study, and it shows a very complete knowledge of the subject, as well as much skill in surmounting difficulties.

As may be seen, whatever be its practical value, Mr. Bessolo's motion is very curious; it shows the first appearance of parts and arrangements that have been thought to be of later origin, and constitutes a very curious point in the history of the science.

We have said that the principles that it contains and the very arrangements it shows were found reproduced later on. The following is an example of it: In 1881, at the Palace of Industry, in the electric exhibit of Siemens and Halske of Berlin, there figured a motor whose external aspect is shown in Fig. 6. This apparatus was styled an "open-ring dynamo-electric machine"—a designation better calculated to deceive than enlighten. It did not appear at any other exhibition, and it is only recently, through a patent taken out in the name of C. Siemens, of London, that we have been enlightened upon it. This patent, of the 16th of February, 1882, is accompanied with drawings that we reproduce in Figs. 8, 9, and 10, an examination of which will at once show what we have to deal with. Fig. 8 shows the ring composed of iron in one part and of a non-magnetic metal in another. In this machine, this ring, instead of being round, is flat and long and in the form of a cylinder—a bad arrangement. Figs. 9 and 10 show a side view and a section of the machine. It is easy to recognize, in Fig. 9, the sectional solenoid divided into three parts, for the support of the movable core. Fig. 10 shows the rollers that serve for such support. Those of one extremity have beveled edges in order to maintain a position in the direction of the axis, and at the other end there is a toothed roller that forms a pinion and receives the motion. As may be seen, we find ourselves here exactly in face of the Bessolo motor. There is only one point of difference, and that is in the distributer. As may be seen in Fig. 9, the sections which compose the solenoid terminate in springs, *o o'*, which carry their extremities over to the center. On referring to Fig. 10 we find these springs at *o* and *o'*. They form the generatrices of two conical surfaces, and abut in pairs against a central circle. When the springs touch, the circuit is continuous. But upon the axis there are two rods that carry a species of knife-edge, *r* and *r'*, and it is by these rods that the current is led. The knife edges are inserted between the rods, which touch one another. The knife-edge, *r*, is a conductor only to the right, while *r'* is a conductor only to the left, so that the current goes from one to the other, but only in a single direction. Mr. Siemens has thus solved the problem of which Mr. Bessolo had, in our opinion, given a better solution. What we have just seen in the machine patented in 1881, explains the one exhibited in 1882 (Fig. 6). It, also, has a two-metal core, something that the catalogue calls an "open ring." The solenoid consists of 18 sections. The machine differs from the preceding only in the distributer, which is again different. Here the bobbins, which are united in three groups (Fig. 7), are individually connected with the flat springs that are seen in the machine. Each of these springs carries a little roller beneath; and the revolving cylinder, for its part, carries projections that, at the proper moment, strike the little roller, lift the spring, and cause a contact. Here again is a solution of the same problem. As may be seen, the details differ, but the principle is exactly the same as in the Bessolo machine. The last coincidence, a curious one, will be pointed out in an article that Mr. Deprez proposes to soon publish upon this subject.

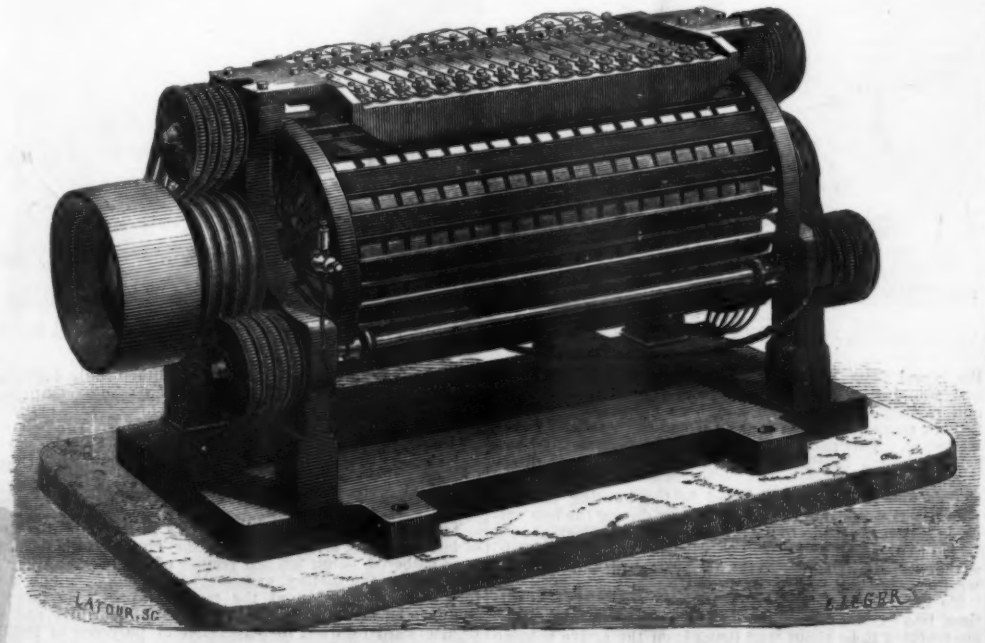


FIG. 6.—SIEMENS' OPEN-RING ELECTRIC MOTOR.

There is no doubt that the principle of this entire series of apparatus dates back to Mr. Bessolo, and, along with it, a number of arrangements that are very complete and the most ingenious that have ever been devised in order to apply this sort of ideas. It is nearly certain that these machines are faulty as regards a mechanical aspect, but electrically they are very well conceived. It is not probable that the Italian inventor saw the fult extent, the value and the consequence, of the principle that he was applying, and which have been brought to light only by much more recent experiments; but it is none the less remarkable that he applied them in so logical and so ingenious a manner.—*La Lumiere Electrique.*

NOTES ON THE VOLCANIC ERUPTION OF MOUNT ST. AUGUSTIN, ALASKA, OCT. 6, 1883.*

ON the western side of the entrance to Cook's Inlet (45 miles wide) lies Cape Douglas; and to the northward of the cape the shore recedes over 20 miles, forming the Bay of Kamishak. In the northern part of this bay lies the island of Chernaboura (black brown), otherwise called Augustin Island. It is 8 or 9 miles in diameter, and near its northeastern part rises to a peak called by Cook, Mount St. Augustin. As laid down by Tebenkoff, the island is nearly round. The northern shores are high, rocky, and forbidding, and are bordered by vast numbers of rocks and hidden dangers. The southern shore is comparatively low.

Mount St. Augustin was discovered and named by Capt. Cook, May 26, 1778; and he describes it as having "a conical figure, and of very considerable height." In 1794 Puget describes it as "A very remarkable mountain, rising with a uniform ascent from the shores to its lofty summit, which is nearly perpendicular to the center of the island, inclining somewhat to its eastern side. . . . Toward the sea side it is very low, from whence it rises, though regular, with a rather steep ascent, and forms a lofty, uniform, and conical mountain, presenting nearly the same appearance from every point of view, and clothed with snow and ice, through which neither tree nor shrub was seen to protrude; so that, if it did produce any, they must either have been very small, or the snow must have been sufficiently deep to have concealed them."

At that time there were native hunters, under the direction of two Russians, hunting or living in the vicinity of the northeastern point of the island.

Vancouver placed the peak of this mountain in latitude 59° 22'; Tebenkoff places it in latitude 59° 24'.

The peak of St. Augustin is distant 49 miles nearly due west (true) from the settlement on the southern point of Port Graham, or, as it is sometimes called, English Harbor. This harbor is situated on the eastern side of Cook's Inlet, near Cape Elizabeth.

In connection with the fall of pumice dust at Iliuliuk, on October 16, 1883, it may be of interest to observe that the peak of Augustin is over 700 miles to the northeastward of Bogosloff Island, off Unalashka (see map).

About eight o'clock on the morning of October 6, 1883, the weather being beautifully clear, the wind light from the southwestward (compass), and the tide at dead low water, the settlers and fishing parties at English Harbor heard a heavy report to windward (Augustin bearing southwest by west three-fourths west by compass). So clear was the atmosphere that the opposite or northwestern coast of the inlet was in clear view at a distance of more than 60 miles.

When the heavy explosion was heard, vast and dense volumes of smoke were seen rolling out of the summit of St. Augustin and moving to the northeastward (or up the inlet) under the influence of the lower stratum of wind; and at the same time (according to the statements of a hunting party of natives in Kamishak Bay) a column of white vapor arose from the sea near the island, slowly ascending, and gradually blending with the clouds. The sea was also greatly agitated and boiling, making it impossible for boats to land upon or to leave the island.

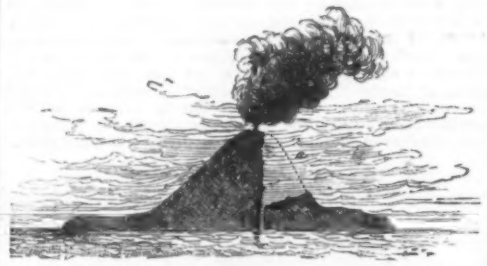
From English Harbor (Port Graham) it was noticed that the columns of smoke, as they gradually rose, spread over the visible heavens and obscured the sky, doubtless under the influence of a higher current (probably north or northeast). Fine pumice dust soon began to fall, but gently, some of it being very fine and some very soft, without grit.

At about twenty-five minutes past eight, A.M., or twenty-five minutes after the great eruption, a great "earthquake wave," estimated as from 25 to 30 feet high, came upon Port Graham like a wall of water. It carried off all the fishing boats from the point, and deluged the houses. This was followed, at intervals of about five minutes, by two other large waves, estimated at 18 and 15 feet; and during the day several large and irregular waves came into the harbor. The first wave took all the boats into the harbor, the receding wave swept them back again to the inlet, and they were finally stranded. Fortunately it was low water, or all of the people at the settlement must inevitably have been lost. The tides rise and fall about 14 feet.

These earthquake waves were felt at Kadiak, and are doubtless recorded on the register of the coast survey tide gauge at that place. Also the pumice ashes fell to the depth of 4 or 5 inches, and a specimen of the deposit was given to the tidal observer at St. Paul. It will be interesting to compare these ashes with those collected at Iliuliuk on the 16th of October, and which, from a confusion of dates, were supposed to have come from the new Bogosloff volcanic island. I am of the opinion that they came from St. Augustin.

The condition of the island of Augustin or Chernaboura, according to the latest accounts, is this:

At night, from a distance of 50 or 60 miles, flames can be



MOUNT ST. AUGUSTIN AFTER THE ERUPTION, AS SEEN BY CAPT. CULLIE, NOV. 10, 1883. *a*, THE ORIGINAL OUTLINE.

seen issuing from the summit of the volcano; and in the daytime vast volumes of smoke roll from it. Upon nearer approach from English Harbor, it was found that the mountain had been split in two from peak to base by a great rupture extending across it from east to west, and that the northern slope of the mountain had sunk away to the level of the northern cliff.* This is corroborated by the statement of the hunting party in Kamishak Bay. Smoke issued from the peak at a very short distance to the southward of the rupture.

The party of natives on Kamishak did not approach the islet, though they gave clear and distinct accounts of its eruption and subsequent appearance; but Capt. C. T. Sands, who was at English Harbor, gave the Alaska company a full description; and Capt. Cullie of the Kodiak states that, if there were plenty of water in the line of rupture, it would be possible for a vessel to sail through (see figure). At the time of Capt. Sands' observations the low ground of the island was visible, and seemed to be a vast crater, from which smoke and flames were issuing.

But beyond all these phenomena, apart from the volcanic eruption and the rupture of the island, we have the report of Capt. Cullie of the schooner Kodiak (from whom we also obtained a statement in regard to the rupture), who approached the island from English Harbor on the 10th of November, and found that a new island, about a mile and a half long and seventy-five feet high, had been upheaved in the ten-fathom passage between Augustin and the mainland to the westward. This passage is from 6 to 8 miles wide, and was sailed through by Puget in Vancouver's voyages of discovery.

This new island (also reported by the hunting party in Kamishak) would appear to have arisen during the late volcanic activity. It lies to the northwestward of Chernaboura Island (Augustin), and was distinctly seen from the Kodiak, as that vessel lay 10 miles to the northeastward, and had clear weather.

To show the violence of the volcanic convulsions at this time, two extinct volcanoes on the Alaska peninsula, which are reported to be about west (true) from the active volcano Iliamna (12,000 feet high), had burst into activity; and during the day volumes of smoke were distinctly seen, and columns of flame at night. Usually, at that season, Augustin and the peak are covered with deep snow. On the 10th of November, however, when Capt. Cullie approached the island, while there was a depth of 4 feet of snow at Port Graham (English Harbor), Mount St. Augustin was bare and black.

During this same season, a party of seven or eight Aleuts had established themselves on Chernaboura (Augustin) Island to hunt the otter during the winter. Two of the women refused to remain on account of the violent noises inside Mount St. Augustin; and they were taken to St. Paul, Kadiak. Since the eruption, no one of this party has been seen nor any signs of their bidarkas, although a rescuing party of natives had gone along the coast to learn of their whereabouts. It is feared, therefore, that they have been destroyed. In confirmation of this report of the native women, Capt. Sands says that he and others noticed that St. Augustin was emitting smoke as far back as August; but no other signs were observed before the heavy report of Oct 6.

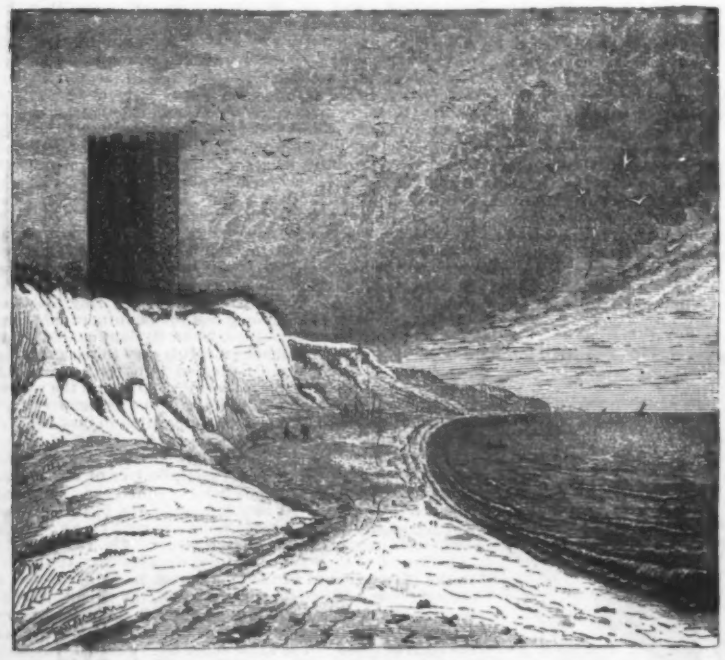
GEORGE DAVIDSON,
Assistant, U.S. Coast and Geodetic Survey.

* Communicated by Prof. J. E. Hilgard, Superintendent U. S. Coast and Geodetic Survey.—*Science.*

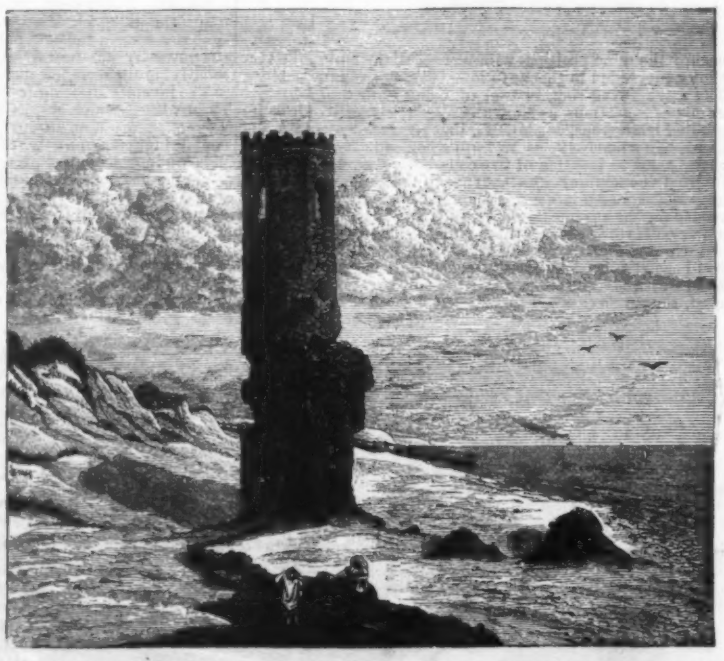
* Capt. Cullie's account.

ECCLES STEEPLE, NORFOLK.

A PLEASURE steamer plies in the summer season three times a week between Yarmouth and Cromer. It is a delightful trip of a few hours along the coast of Norfolk, of which a good view is obtained, as the steamer, being small, runs close inland. Half way between Yarmouth and Cromer is an object which attracts the attention of all on board. A tall, slender tower is seen, standing on the beach, outside the cliffs forming the line of coast. It rises, apparently, out of the sea. In fact, at a high tide, the breakers are seen dashing against the tower. This is Eccles Steeple, the ruin of an old church once standing miles inland. On examination, the cliffs on the coast, north and south of Eccles, show a decided stratification; whereas the bluffs near the tower are composed entirely of dry, loose sand. They are, in fact, nothing but sand dunes thrown up by the sea, such as we see on the coasts of Holland and North Germany. Here in Norfolk they are called marram banks, from a species of grass which grows on them, and extended from Eccles beyond Winterton, close to Yarmouth. In 1884 the late Mr. W. Hewitt, of Norwich, published an essay, dedicated to the Lords Commissioners of the Admiralty, in which he strove to show how to arrest the encroachments of the German Ocean along the coast of Norfolk. In a sketch of the beach of Hasbro', which accompanies his essay, we see Eccles Steeple thoroughly embedded in the dunes, the top part of the tower only projecting. The present appearance of the ruins dates from 1862. During a heavy storm from the northeast in October of that year, the sea washed away the greater part of the sand-hills it had formerly thrown up, laying bare the tower and remains of masonry, part of the old church of Eccles-by-the-Sea. Since that occurrence a series of breakwaters, such as were suggested by Mr. Hewitt, have been constructed, and the state of the beach between Hasbro' and Eccles has undergone but slight further changes. This is one of the many parishes on the coast that have from time to time fallen a prey to the German Ocean. Shipden, Keswick near Bacton, and Whimpnell, between Hasbro' and Eccles, have entirely disappeared. The hamlet of Eccles by the Sea was part of the great lordship of Hasbro' or Happisburgh. It originally contained over 2,000 acres of land, but was so wasted by the incursion of the sea that the inhabitants, in their petition for reduction of taxes in the reign of James I., complained they had then only fourteen houses and 300 acres of land. Now, the whole comprises but 150 acres, a few cottages, the ruined tower of the church, dedicated to St. Mary, and sixteen inhabitants. The present rector of the parish is the Rev. J. F. Osborne, who used occasionally to hold services in the open air in front of the tower.



ECCLES STEEPLE, NORFOLK, BEFORE THE STORM OF OCTOBER, 1862.



ECCLES STEEPLE, NORFOLK, SINCE THE SAND CLIFFS WERE WASHED AWAY.

THE total number of cinchona trees in Bengal at the end of last year was 4,711,168, while the crop was the largest ever gathered, being 396,980 pounds of dry bark. All this was sent to the factory, except 41,800 pounds, which was forwarded to London at the request of the Secretary of State, to be made up in different forms of febrifuge and to be afterward returned for experimental purposes to India. The revenue derived from the sale of plants and bark was equal to 6½ per cent. on the capital invested.

THE IMPORTED ELM-LEAF BEETLE.

(*Galeruca xanthomelæna** Schrank.)

Order COLEOPTERA; family CHRYSOMELIDÆ.

THE depredations of this pest have now become widely extended throughout the Northeastern States, rendering almost worthless and unsightly those most valuable shade trees of our cities—the elms. As its injuries are so far unknown in the Mississippi Valley, the blighted appearance of the elms on the Department grounds, in midsummer, and especially of the European varieties, at once attracted our attention when we first came to Washington, and a series of experiments was begun with a view of checking the ravages of the insect. The excellent opportunities thus offered for experiment and study have since been improved, and, with some prefatory passages in relation to the history and habits of the beetle, we will give the practical results reached.

AN IMPORTATION FROM EUROPE.

This beetle has done great mischief in the Old World, especially in Germany and France, and it is very important that the public know the best method of coping with it here. According to Glover, it was imported as early as 1837. Its distribution was formerly confined to limited areas near the coast, and its earlier attacks were notably about Baltimore and New Jersey.

HABITS AND NATURAL HISTORY.

The general characteristics of this insect have been pretty well studied abroad. Mr. E. Heeger has given an excellent account of its life-history, with a detailed description of the larva and figures illustrating larva and pupa, and anatomical details. More recenly M. Maurice Girard has given a rather poor wood-cut illustration of the insect and its work, with the leading facts concerning its nomenclature and natural history as observed in Europe. Biological notes on the insect have also been given by Leinweber and Kollar.

In our country the life-history of the insect and its injury have been referred to by Harris, Fitch, Morris, Walsh, and ourselves, while the agricultural papers contain numerous references to the injury inflicted by the insect. The perfect beetle has often been described in systematic works on Coleoptera.

For these reasons we deem it unnecessary to enter here into a detailed description of the beetle and its earlier stages, but content ourselves with pointing out the more obvious characters, alluding to such facts of the life-history as are necessary to a full understanding of the nature of the remedies to be applied for this pest.

The eggs are deposited in an upright position upon the under side of the leaves, always in a group, consisting generally of two, rarely three, more or less irregular rows. The individual eggs are close together in each group, and so firmly fastened to the leaf that they can only be detached with great care without breaking the thin and brittle shell. The number of eggs in each group varies from four or five to twenty or more. Very rarely only three eggs are seen in one group, but we never found less than that number. The egg itself is oblong, oval, obtusely, but not abruptly, pointed at tip, of straw-yellow color, its surface being opaque and beautifully and evenly reticulated, each mesh forming a regular hexagon. The form of the eggs is not quite constant, some of them, especially those in the middle of a large group, being much narrower than others. The duration of the egg state is about one week.

The larvæ are destructive to the foliage from the month of May until August. They have about two weeks of active life between the egg and pupa states. During this time they prey upon the leaves, which become skeletonized, leaving the venation, and commonly a certain portion of the flesh of the leaf, which becomes rust-brown. They undergo four molts, respectively observed at Washington on July 15 (at hatching), 20, 23, and 29 (pupation). When full-grown they descend to the ground and change to pupa under whatever shelter is near to the base of the tree.

The pupa is of brighter color than the larva, oval in shape, and strongly convex dorsally. It is sparsely covered with moderately long but very conspicuous black bristles, irregularly arranged on head and thorax, but in a transverse row on each following segment. The pupa state lasts about from six to ten days.

The beetle assists the larva in its destructive work, but, as is usual in such cases, the damage done by the perfect insect is small when compared with that done by the larva. There are three or four annual generations of the insect, according to the character of the season. In the month of September the beetles prepare for hibernation, seeking shelter in hollow trees, in the ground, under old leaves, etc., and remain dormant until the following spring.

REMEDIES.

M. Girard says:

There is no other means of destruction than to jar the branches over cloths to collect the larvæ and adults which fall. It is also possible, when they are on the ground, to distribute on them boiling water or steam, or even quicklime or solution of sulphocarbonate of potassium.

In our own country much more has been accomplished toward practically combating this insect.

Mr. Glover regarded the pupa state as the most favorable in which to kill the insect, as it can then be easily crushed or scalded. Concerning the tobacco treatment he adds that "syringing the trees with strong tobacco water has been tried with some good effect, but the larvæ not touched by the fluid are merely knocked down by the concussion, and if nearly ready to change into pupæ, effect their transformation where they fall."

MORE RECENT EXPERIENCE AT THE DEPARTMENT.

The more recent experience in the destruction of this Galeruca on the Department grounds may now be summed up, the experiments having been intrusted to Dr. Barnard.

Past History of the Elms in Question.—According to Mr. William Saunders, of this department, these trees have been annually attacked by the European elm-leaf beetle since they were planted ten years ago, and about one year in three the injury has been severe, resulting in their defoliation, while in other years, as in 1879 and in 1880, there appeared comparatively none. In some seasons a second or autumnal set of leaves appeared after the trees had been stripped, and in certain of these instances the second crop of leaves became eaten; but in all cases he thinks the lives of the trees have not seemed to be endangered, and they soon repaired the damage done. His belief is also that the pest did not become gradually worse and worse through the series of years during which it has been observed by him, still he regards the attack of 1882 as worse than any known to him before on these trees or others, and he has noticed the effects of this insect since 1850, first in its earliest ravages about Baltimore, and later elsewhere.

Condition and Characteristics of the Grove in 1882 and 1883.—However it may be for the past history or future desirability of certain trees in the grove, in 1882 many exhibited various grades of feebleness, and some had dying branches. Indeed, a few of them had a very unhealthy aspect the previous year also. Of course it can be claimed that their unhealthy condition is due to other causes than the insects; and it should be remembered that most are foreign species, each often represented in two or more of its varieties. Here all grow on level ground, whereas in a state of nature some belong to mountainous localities; others to the damp climate of England, etc. Therefore, many of them are growing under abnormal conditions. They exhibit much variety in the relative abundance, size, form, and texture of the leaves. There is also great diversity in the density and form of branching.

Extent of Injury in 1882 and 1883.—All the varieties and species of elms in this grove, without exception, were preyed upon by the pest in 1882 and 1883. The insect, however, showed decided preferences for certain individual trees, varieties, or species, stripping some completely before doing more than very slight harm to the leaves of others, the former becoming completely eaten in midsummer, the latter not until toward the close of the season, or remaining only slightly damaged until then. In 1882 the leaves were eaten faster than they could be developed, and the insect continued abundant enough to prevent a second crop of foliage until in November, when it became too cold for the leaves and active insects to exist.

On these grounds the southeast side of each tree has suffered more than the northwest half. This peculiarity has been very strongly pronounced this year—1883—on all the trees affected, and upon some examples far more markedly than upon others. This one-sidedness is especially apparent in the trees which were the most severely eaten. Some trees show the southeast side completely devoured, but the northwest side only half consumed and comparatively green. Such are average cases.

The inferences have been, that the shade, dampness, and coolness of the tree on the northwest side during the morning is too unhealthy for the favorable development of the larvæ or of the eggs deposited there; but whether this be true or not, the insect probably prefers to deposit chiefly in the middle of the forenoon, and on that part of the tree which is then warmest. This would give a greater number of the eggs at the outset on the southeast side, as observation seems to confirm, and since the young larvæ do not migrate to any noteworthy extent, the one-sidedness described would result, whether the northwest side were unhealthy or not. The former explanation is probably the most correct one, as we have noticed that the insect is less injurious during very wet summers.

Preferences of the Elm Beetles for Certain Varieties and Species of Elms.—The American slippery elm does not occur in this grove, but only one native species, the common American elm, *Ulmus americana*. This is practically free from the ravages of the beetle, on which account it may be preferred to the European species. It is tall, and has gracefully arched branches, making it as ornamental as any European kind, yet as a shade tree it does not equal the *U. montana* of the Old World. The latter has a broader, denser crown, but the attack on it is considerable enough to leave the choice in favor of the American species.

U. montana seems the best European species grown here for shade, since the other foreign elms here cultivated are not dense enough. This applies to *U. campestris*, *U. suberosa*, *U. effusa*, and *U. parvifolia* (*siberica*). The last named is not attacked as much as the American. The young larvæ cannot develop on it, but die quite soon, without growing, and they gnaw the leaves very little. The other foreign species mentioned are seriously eaten; the severest attack being upon the *U. campestris*, the favorite food of this insect.

As early as June 25, in 1883, this species was completely eaten and brown in our grove, at which date the *U. montana* examples retained more than half their verdure; in some individuals nearly all; and the common American elm was perfectly green. The *U. campestris* is one of the poorest elms for shade, and its total abolishment throughout the entire country would probably lessen the assault on *U. montana* to a comparatively unobjectionable extent. This measure should be instituted against the pest, and for the sake of the other species of elms.

Effects of Arsenical Poisons on Insect and Plant.—Species of elms are somewhat differently affected by the poison. When treated alike there is always manifest some difference in the susceptibility of different elms to the corrosive effects of the poison. Even individuals of the same species or variety are differently impaired. As a rule, those which suit the insect best are injured most by the poison, and those which resist the insect most withstand the poison best. The latter have coarser foliage with darker green color and more vigorous general growth; the former have more delicate foliage, lighter in color and weight, apparently less succulent.

Certain elms of the species *U. campestris* and other species which were over-poisoned, and shed most of their leaves in consequence in the last of June, 1883, sent out a profuse new growth of leaves and twigs. The foliage fell gradually for three weeks, and this was somewhat promoted by the succeeding rains.

The larvæ move from place to place so seldom that if the leaves are imperfectly poisoned from the mixture being weakly diluted, or from its application only in large, scattered drops, which are much avoided by the larvæ, they are not killed off thoroughly for several days, and in all cases it requires considerable time to attain the full effect of the poison. This result appears on the plant and on the insect. After each rain the poison takes a new effect upon the plant and the pest, which indicates that the poison is absorbed more or is more active when wet, and that it acts by dehydrating thereafter. Where the tree is too strongly poisoned, each rain causes a new lot of leaves to become discolored by the poison or to fall. On some of the trees the discoloration appears in brown, dead blotches on the foliage, chiefly about the gnawed places and margins, while in other instances many of the leaves turn yellow, and others fall without change of color. The latter may not all drop from the effects of poison, but the coloration referred to is without doubt generally from the caustic action. The poison not only produces the local effects from contact action on the parts touched by it, but following this there appears a more general effect manifest in that all the foliage appears to lose, to some extent, its freshness and vitality. This secondary influence is probably from poisoning of the sap in a moderate degree. When this is once observable, no leaf-eater thrives upon the foliage. Slight over-poisoning seems to have a tonic or invigorating effect on the tree.

Preventive Effects of the Poison.—In this grove the elms that were poisoned in 1882 were attacked in the spring of 1883 less severely than were those which were not poisoned the previous year. This would seem to imply that the insects deposit mostly on the trees nearest to where they develop, and are only partially migratory before ovipositing. The attack afterward became increased, probably by immigration and the new generation, so that later in the season the trees were mostly infested to the usual extent.

In the region of Washington *a preventive application of poison should be made* before the last of May or first of June, when the eggs are being deposited and before they hatch. This will prevent the worms from ever getting a start. By the preventive method the tree escapes two kinds of injury: first, that directly from the eating by the insect; second, that which follows indirectly from the deleterious effects of the poison on the plant, for its caustic effect is much greater where the leaves have been so gnawed that the poison comes in contact with the sap.

Treatment with London Purple.—Already early in June the insect appears plentiful. On June 7, 1882, it was at work on all the trees, and its clusters of eggs were numerous beneath the leaves. Some of the trees had half of the leaves considerably gnawed and perforated by larvæ of all sizes, and by the adults. At this date fifteen trees, constituting the south part of the grove, were treated.

Preparation of the Poison.—London purple (one-half pound), flour (3 quarts), and water (barrel, 40 gallons) were mixed as follows: A large galvanized iron flunnel of thirteen quarts capacity, and having a cross septum of fine wire gauze such as is used for sieves, also having vertical sides, and a rim to keep it from rocking on the barrel, was used. About three quarts of cheap flour were placed in the funnel and washed through the wire gauze by water poured in. The flour in passing through is finely divided, and will diffuse in the water without appearing in lumps. The flour is a suitable medium to make the poison adhesive. The London purple is then placed upon the gauze and washed in by the remainder of the water, until the barrel is filled. In other tests, the flour was mixed dry with the poison powder, and both were afterward washed through together with good results. It is thought that by mixing in this way less flour will suffice. Three-eighths of a pound of London purple to one barrel of water may be taken as a suitable percentage. Three-eighths of an ounce may be used as an equivalent in one bucketful of water. The amount of this poison was reduced to one-fourth of a pound to the barrel with good effect, but this seems to be the minimum quantity, and to be of value it must be applied in favorable weather and with unusual thoroughness. With one half or three-fourths of a pound to the barrel, about the maximum strength allowable is attained, and this should be applied only as an extremely fine mist, without drenching the foliage.

Effects of the Mixture.—The flour seems to keep the poison from taking effect on the leaf, preventing to some extent the corrosive injury which otherwise obtains when the poison is coarsely sprinkled or too strong. It also renders the poison more permanent. On the leaves, especially on the under surfaces, the London purple and flour can be seen for several weeks after it has been applied, and the insect is not only destroyed, but is prevented from reappearing, at least for a long period. By poisoning again, a few weeks later, the insect is deterred with greater certainty for the entire season. By being careful to administer the poison before the insect has worked, and, above all, to diffuse the spray finely but not in large drops, no harm worth mentioning will accrue to the plant from the proportion of poison recommended. The new growth, that developed after the first poisoning, was protected by one-fourth of a pound to the barrel in 1882. From midsummer until autumn the unpoisoned half of the grove remained denuded of foliage, while the poisoned half retained its verdure. The little damage then appearing in the protected part was mostly done before the first treatment. Eggs were laid abundantly throughout the season. Many of these seemed unhealthy and failed to develop, probably because they were poisoned. Many hatched, but the young larvæ soon died. The eggs were seldom deposited on the young leaves that were appearing after the poison was applied, but were attached to the developed leaves, and here the larvæ generally got the poison to prevent their attack upon the aftergrowth. Still, the young leaves became perforated to some extent. The adults, which fly from tree to tree, appeared plentiful without much interruption throughout the season, and often several could be seen feeding on each tree. Possibly many of these may have become poisoned before depositing the eggs.

The efficiency of London purple being established, it will generally be preferred to other arsenicals, because of its cheapness, better diffusibility, visibility on the foliage, etc. As the effects of the poisons commonly do not appear decidedly for two or three days after their administration, the importance of the preventive method of poisoning in advance cannot be too strongly urged. As the effect is slow in appearing, impatient parties will be apt to repoison on the second or third day, and thus put on enough to hurt the plant when the effect does come. Much depends on dryness or wetness of the weather; but good effects may be expected by the third or fourth day.

London purple seems to injure the plant less than Paris green.

Treatment with Paris Green.—In 1883 the Paris green was first applied on the 29th of May, at which date the eggs were extremely abundant and hatching rapidly on the leaves. Paris green, flour, and water were mixed by the means previously employed with London purple and already described. The mixture was applied to the north part of the same grove of elms. Thus far experience shows that the Paris green is effective against the insect, but that this poison injures the plant more than does the London purple.

Three-fourths of a pound of Paris green to a barrel (36 or 40 gallons) of water, with three quarts of flour, may be regarded as a poison mixture of medium or average strength for treating elms against these beetles, and the indications thus far are that the amount of Paris green should not be increased above one pound or be diminished much below one-half a pound in this mixture. To a bucketful of water three-fourths of an ounce of Paris green may be used. The action of this poison is slow but severe, and varies much with the weather. Thus far the results of tests have been varied so much by the weather and different modes of preparation and application that they will be repeated. When used strong enough to cauterize the leaves, the poisonous action upon the plant may be observed to continue for several weeks.

Mechanical Means of Applying the Poison.—When many trees were to be sprayed a cart or wagon was employed to haul the poison in a large barrel provided with a stirrer, force-pump, skid, etc. The following brief account of the

*This is the *Galeruca cratægi* Forst., and *G. calmariensis* Fabr. In Crotch's Check List it appears as *Galerucella xanthomelæna*.

skid, mixer, barrel, and pump may be reproduced here from our last annual report:

The skid is a simple frame to hold the horizontal barrel from rolling, and consists of two pieces (Plate VI., Fig. 3, *a a*) of wood, about the length of the barrel, and in section about 3 by 4 inches, joined parallel, apart from each other, by two cleats, *b b*. The inner upper angles may be cut to match the curve of the barrel, as at *c c*. The barrel being placed upon this frame is next to be filled.

A good device for mixing the poison thoroughly with the water and filling the barrel is shown in section in Plate VI., Fig. 4. It consists of a large funnel that will hold a bucketful, and has cylindrical sides, *g g*, that rest conformant on the barrel. In this is a gauze or finely perforated diaphragm, or septum, *d*, and a funnel base, *j j*, with its spout, *p*, inserted through the bung.

By reference to Plate VI., Fig. 4, the barrel, *k*, will be seen in section, and some of its details, together with those of the pump and stirrer, may be noticed. The fulcrum, *f*, has a foot below, screwed to the barrel. Through its top is a pivot, *o*, on which tilts the pump-lever, *l*, which is similarly hinged at *b* to the top of the piston-rod, *t*. The pump cylinder, *g*, is also hung upon trunnions, *i*, projecting into eyes. In this illustration the eyes, *e e*, have each a neck fitting in a slot cut through the stave, oppositely from the side of the bung-hole, and beneath the stave is a foot on the eye-piece. Its neck is so short that the eye is held down firmly against the top of the stave, while the foot is as tight against its under surface. The length of its eye-piece is a little less than the diameter of the bung-hole, into which it may be inserted to be driven latterly into the slot. The slot is longer than the eye-piece, so the latter may be driven away from the bung-hole for a distance greater than the length of the trunnion pivot. Then the pump being inserted until these pivots come opposite the eyes, the latter may be driven back as sockets over the pivots, which play in them when the pump is worked. To hold these eyes toward the pump and upon the trunnions a wedge, *v*, is driven in the slot beyond each eye-piece. Thus the pump is easily attached or removed, and its union with the barrel is strong and firm. Perchance it be desired that this pump-hole be bunged, the side slots may be wedged to make the barrel tight.

The parts of the pump being hung as described, the hinge, *b*, forms a toggle-joint, and in its action causes the pump to oscillate on its trunnions, its basal end swinging wider than its top, as indicated by the dotted line from *x* to *y*. Upon the extremity of this swinging end is a loop, *h*, through which is passed a stirrer-bar, *m n*, made to sweep back and forth in the lower side of the barrel, thus to agitate and mix the substances considerably during the operation of the pump, every stroke of the handle causing one or two strokes of the stirrer.

The method of inserting and extricating the stirrer bar is as follows: It is raised with the pump until the end, *m*, comes opposite the bung-hole, *x*, through which the bar may be pulled out by the cord, *w*, which is attached to the end, *n*, and also preferably to the bungs, *r* and *z*, as shown. Through the same hole the bar may be inserted. This stirring device is the simplest in construction and operation of any yet contrived, while working as its does with reference to the concavity of the barrel it is perfectly effective.

The pump is double acting and very powerful, giving strong pressure to disperse the liquid far and finely, for with the eddy chamber nozzle used, the greater the pressure the finer is the liquid atomized. A block or other catch may be fixed on the side of the barrel to fit against the skid and prevent the barrel from rocking therein, as might otherwise happen when it is nearly empty if much power is applied. About one pailful of poisoned water was sprayed upon each tree. When only two or three trees were to be treated, an aquapult or other bucket pump was used to force the poison from a bucket carried by hand. The Paris green mixture needs to be almost constantly stirred, as this poison precipitates quickly; but with London purple the agitation is only occasionally necessary.

Connected with either pump is a long, flexible pipe, with its distal part stiff, and serving as a long handle whereby to hold its terminal nozzle beneath the branches or very high up at a comfortable distance from the person managing it. Parts of one form of this extension pipe are shown in Figs. 1 and 2.

To the pump spout is attached the long, 2 ply, flexile hose, *A A*, of ¼ inch caliber. Its considerable length, 12 feet or more, allows the nozzle to be carried about the tree without moving the pump. Beyond its flexile part the hose, *A*, passes through a bamboo pole, *b*, from which the septa have been burned out by a hot iron rod. At the distal end of the pole the hose terminates in a nozzle, *n* or *m*. When the nozzle is in its natural position, *m*, the spray, *s*, is thrown straight ahead, and this suits well for spraying very high branches, but for spraying the under surfaces of the lower parts of the tree it is necessary that the nozzle discharge laterally from the pipe, and this is accomplished with a nozzle having a direct discharge by bending it to one side. The nozzle, *n*, and spray, *s*, are directed laterally, and the nozzle, *n*, is maintained in this position by a metallic hook or eye, *v*, having a crooked stem inserted at the side of the hose in the end of the pole. Where the side spray is permanently desired, the metallic stem is inserted inside the hose and connected with the base of the nozzle, or the tubular stem of the nozzle is given the desired crook. For small trees the simpler extension pipe shown in Fig. 2 is satisfactory. The metallic tube, *t*, several feet in length, is used as the stiff part, *t*, connected with the hose A. One longer metallic pipe, having telescopic sections made tight by outside segments of rubber tubing, has also been employed, and is a very desirable extension pipe. Where only low end spraying is to be done, as upon small trees, etc., the eddy chamber nozzle is set upon such a pipe, or upon its own stem, so as to discharge at right angles therefrom; but a diagonal position of the chamber, *n*, on its stem, *t*, throws the spray, *s*, at an intermediate angle between the right angle and a direct line, by which, without any readjustment, the spray, *s*, can be directed high or lower, beneath the foliage or above. For general use, this kind of nozzle is the best. With ordinary force pump pressure the discharge hole of the nozzle is about one-sixteenth of an inch in diameter for misty sprays with particles invisibly small. Rather than use the larger, coarser sprays, which were usually employed in these tests, it is better to use the finest spray. The spray falling upon the extension pipe soon accumulates enough to flow down the pole and wet the hands. To prevent this a wrapping washer of leather or other flange may surround the pole proximally from the spray, and the drip will drop off from its margin. Such an arrangement is indicated at J in Plate VI., Fig. 1.

While one person operates the pump, another standing in the vehicle or upon the ground directs the spray by the stiff part of the pipe. Thus the operator cannot only spray higher and lower with convenience, but he can, to a great extent, move the spray from place to place without leaving his own position and without moving the vessel of poison with the pump.

The hose and bamboo combination was conceived of, and used as the lightest, long, stiff tube practicable for these purposes, and it has answered admirably. A similar pole, with a metallic tube in its interior, with a nozzle not producing the very fine mist desired, and lacking the side discharge, etc., was afterward learned of as being used in California. (See Agricultural Department Report, 1881–82, p. 208.)

By the apparatus used, when everything is prepared, a tree can be sprayed quickly, and a large grove is treated in a short time. It is equally adapted for forestry use in general,

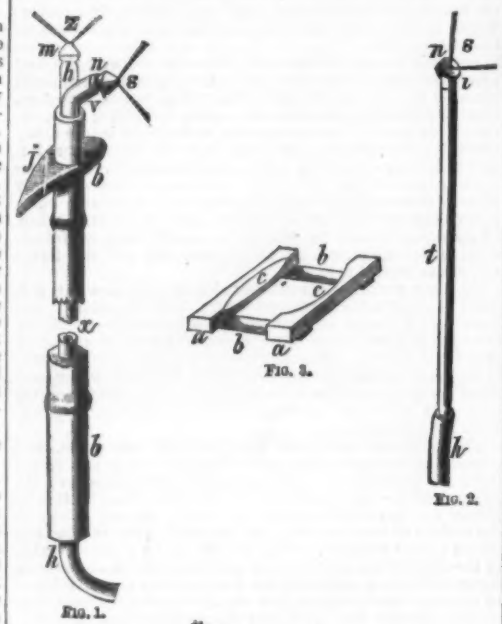


FIG. 1.

FIG. 3.

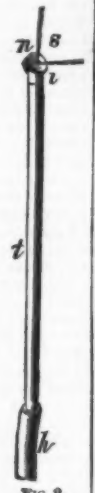


FIG. 2.

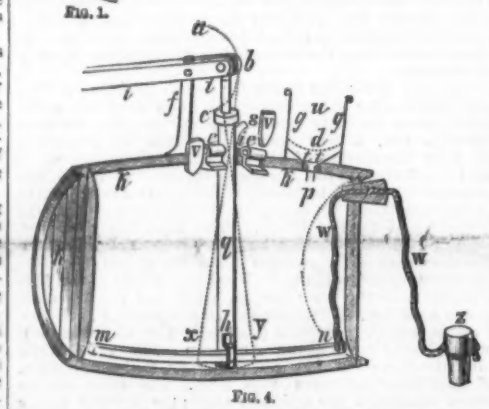


FIG. 4.

PLATE 6.—DEVICES FOR UNDERSPRAYING TREES.

and likewise available for poisoning on fruit trees, when not in fruit, while the shorter style of extension pipe is convenient for underspraying all kinds of low plants.—*C. V. Riley, Report of the Entomologist.*

THE VISUAL AREA IN THE BRAIN.

RECENT research in cerebral physiology has been directed toward the subject of the localization of sensory areas on the cortex of the brain, and has been productive of many very interesting discoveries. The investigations of Wernicke and Stilling in the anatomy of the brain, and the observations of numerous pathologists in cases of hemianopsia, have confirmed in such a striking manner the conclusions of the physiologist Munk regarding the cortical area governing vision, that a summary of the facts, made by Dr. M. Allen Starr, in the January number of *The American Journal of the Medical Sciences*, deserves attention. A knowledge of these facts is necessary both for the exact examination of cases and for an accurate report of autopsies, as it seems probable that many errors in the past have been due to the imperfect investigations of symptoms and of lesions.

From an analysis of thirty-two recorded cases with autopsies, Dr. Starr reaches the following conclusions regarding the pathology of hemianopsia:

Later homonymous hemianopsia may be produced not only by a lesion of one optic tract, but also by a lesion situated either in the pulvinar of one optic thalamus, in the posterior part of one internal capsule or its radiation backward toward the occipital lobe, in the medullary portion of the occipital lobe, or in the cortex of one occipital lobe. Extensive or multiple lesions involving two or more of these portions of the brain produce the same symptom. Hence, a lesion in the course of the optic fibers of one side, at any point between the optic chiasm and their termination in the cortex of the occipital region, produces partial blindness of both eyes. It is, therefore, justifiable to conclude that the occipital lobe of each side is in anatomical and functional relation with both eyes; in such a manner that the like-named sides of both retinæ are connected with the like-named hemisphere, *e. g.*, the right sides of both retinæ with the right hemisphere, and *vice versa*. When a lesion of one hemisphere involves the optic fibers, at any point, partial blindness of both eyes, and not blindness of the opposite eye, is produced.

Any form of brain lesion, abscess, embolic softening, hemorrhage, tumors, chronic meningitis, if located in the course of the optic fibers or on the surface of one occipital lobe, may produce hemianopsia. The symptom is not due, therefore, to the shock of an apoplexy or embolism, nor to an increase of intracranial pressure; as cases occur in which neither of these conditions is present. It must, therefore, be regarded as a symptom indicating a local circumscribed lesion of one hemisphere, and not a general symptom (such as headache or coma) of brain disease.

A study of the cases cited leads to the inevitable conclusion that the visual area lies in the occipital region, that the symptoms other than visual cannot be referred to any lesion except to that of the occipital lobe, and that the right occipital lobe receives impressions from the right half of both eyes, and the left occipital lobe from the left half of both eyes.

With these facts in view the question arises, Are there any means of locating the lesion present in a case of hemianopsia? Reference is here made to lateral homonymous hemianopsia. All other forms are due to a lesion of the optic chiasm or optic nerve. A review of the cases and a comparison of symptoms with lesions will demonstrate that this is impossible. The lesion producing the hemianopsia may lie at any point in the course of the optic fibers from the chiasm to the occipital cortex, and in all cases the character of the hemianopsia may be the same. It is only from a study of the accompanying symptoms, therefore, that the lesion can be located. But each of the other symptoms may be due to lesions situated at various points. If it can be proved from a study of the other symptoms that the lesion must be in one definite position, and at the same time a lesion in that position would intercept the visual tract, a probable diagnosis may be reached.

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